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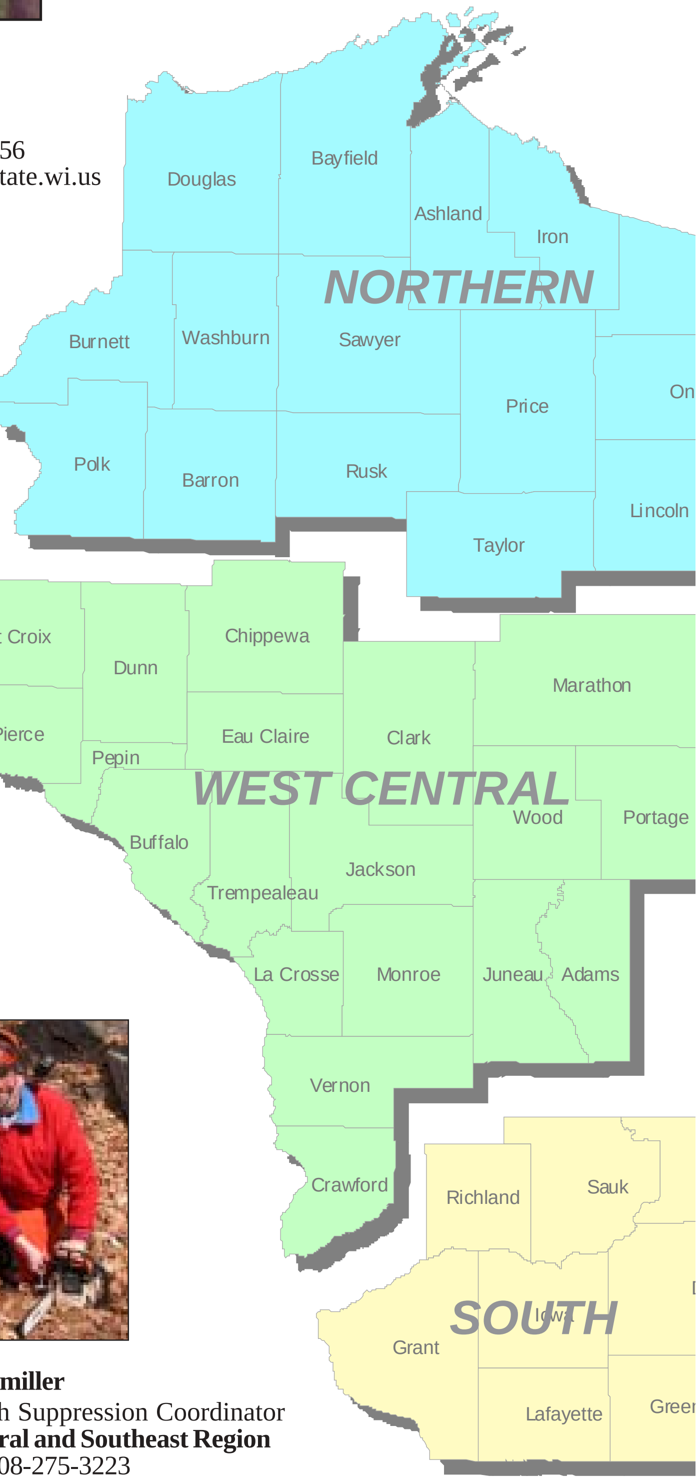

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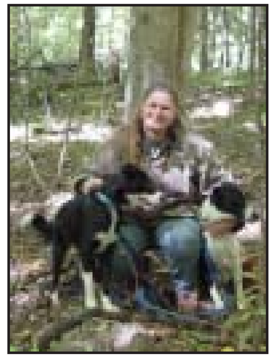

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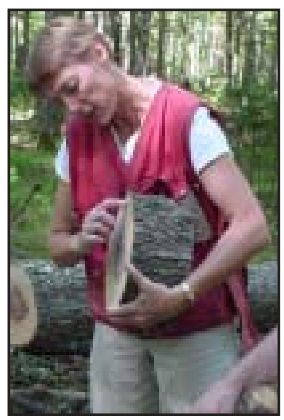

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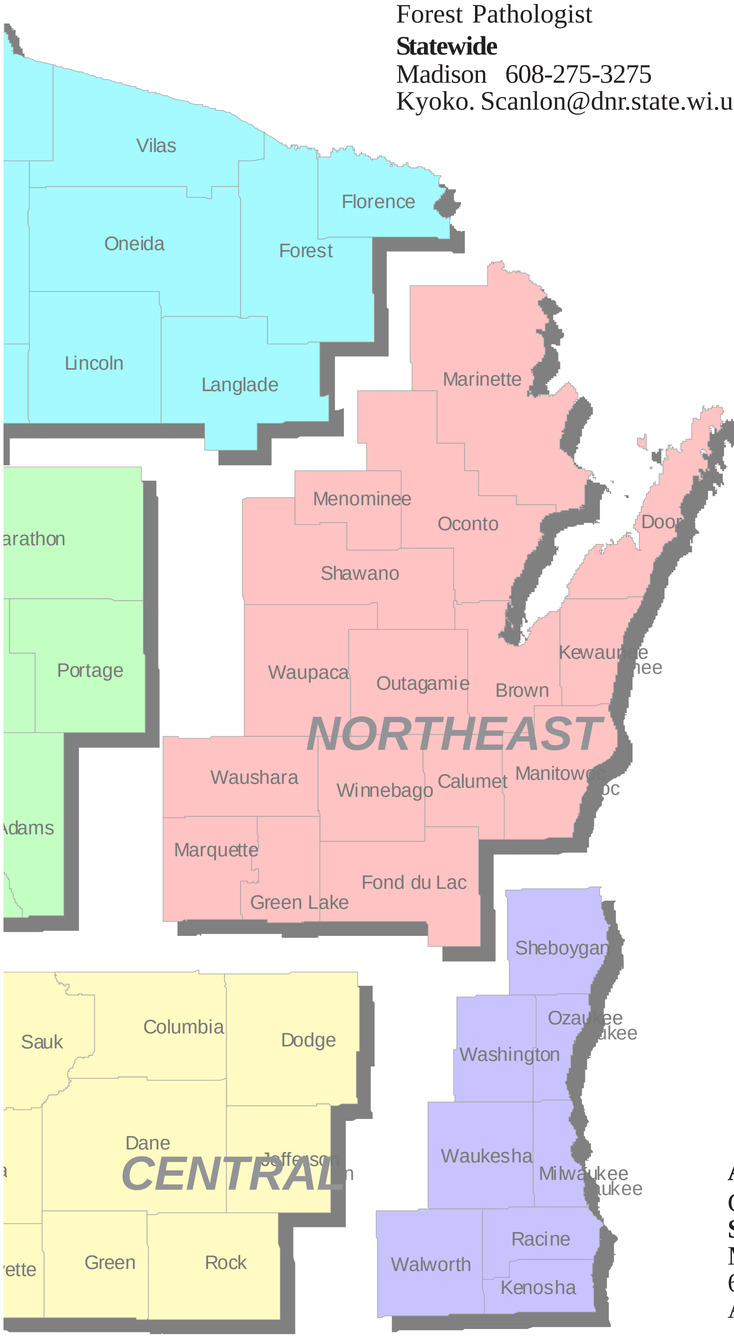

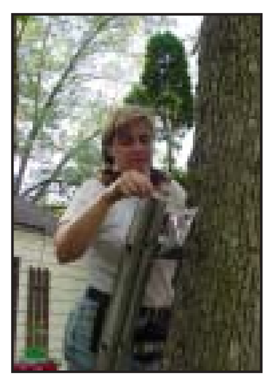

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Alerts

Jack Pine Budworm

Jack pine budworm *(Christonuera pinus)* populations increased across the north producing about 36,000 acres of moderate to heavy defoliation. While almost 2/3 of the defoliation occurred in Douglas County, small pockets (~40-50 acres) of intense feeding were found as far east as Vilas and Oneida counties. Population surveys indicate a high probability of an outbreak (100,000 acres or more) in 2005.

In the West Central Region, the jack pine budworm population didn't increase as expected from egg mass counts in 2003, probably due to cold wet spring weather. However, moderate to heavy defoliation occurred in Eau Claire and Marathon counties. Populations decreased in all counties except Marathon County where moderate to heavy defoliation can be expected in 2005. In Adams County, light defoliation of red pine was thought to be due to jack pine budworm, as indicated by the type of feeding damage and pupal cases. This phenomenon has also been reported in Minnesota.

Common Pine Shoot Beetle

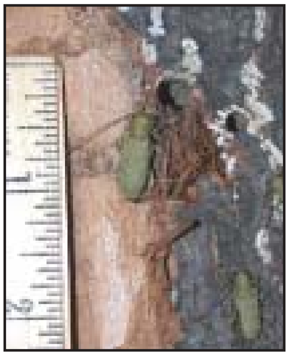
—As of July 1, 2004, nine counties were under quarantine in Wisconsin for common pine shoot beetle(*Tomicus piniperda*). Quarantine counties are Dane, Grant, Green, Jackson, Kenosha, Lafayette, Rock, Sauk, and Walworth. A county is designated as quarantined once a beetle is found. Quarantine means that the movement of the following materials is regulated: pine shoot beetle in any living stage, live or cut plants of *Pinus* spp. (larger than 18 inches in height), timber or logs of *Pinus* spp. with bark attached and ornamental foliage from *Pinus* spp. The movement of the regulated materials from quarantined to non-quarantined counties is prohibited unless they are inspected and certified by the Wisconsin Department of Agriculture, Trade and Consumer Protection (DATCP) or USDA Animal and Plant Health Inspection Service (APHIS). Receiving mills (saw and pulp) in non-quarantined counties must have a signed compliance agreement and are not allowed to receive pine logs from regulated areas from April 1 to July 1. Outside of that time frame, mills must process the regulated logs by April of the following season. As of March 21, 2005, DATCP had developed a list of procedurs that must be followed if pine material is moved from a quarantine county to a nonquarantine county from April 1 to July 1. If such movement is needed, contact Bob Dahl with DATCP (tel. 608-224-4573) for further information. If you plan to set up a timber sale of *Pinus* spp. in quarantined areas, make sure to avoid the transportation of logs to mills in non-quarantined counties during the restrictive period.

Beech Bark Disease

– Beech bark disease is a combination of a scale insect and a nectria canker which, together, can kill beech trees. The scale insects infest the tree bark (photo at left) by inserting their mouthparts into the bark and sucking sap. This process allows the nectria fungus to get into the tree and start to produce cankers. Multiple cankers on a tree may coalesce and effectively girdle the tree.

Beech bark disease is not yet in Wisconsin but has reached the eastern Upper Peninsula of Michigan and is moving closer each year. In the eastern US, where beech bark disease has been present since 1929, there are some trees that appear to be resistant to the scale/disease and have survived. In Michigan's Upper Peninsula, where the disease is still new, most of the beech trees are dead or declining. However, after this first "hit", there should be a few trees left that are not as susceptible to the disease and that can, hopefully, survive.

Linden Borer



– This longhorned beetle (*Seperda vestita*) attacks linden trees by boring under the bark as well as boring deeply into the wood of the tree. These native beetles seem to prefer trees that are under stress but it's not clear how stressed the tree has to be for it to be attractive to these insects. The larvae (photo on right) begin life by feeding in the cambium layer underneath the bark but as they grow older they can invade the wood of the tree and they will bore deep into the wood when they are ready to pupate. Adults chew a perfectly round hole out of the tree, approximately the size of a pencil, or slightly larger (photo on left). Their damage can effectively girdle portions of the tree, sometimes killing the whole tree. Currently, linden borer problems are most common in Milwaukee, Madison, some areas around Green Bay, and Appleton. Many communities report that damage from this insect occurs mostly in the lower portions of the trunk up to the first main branch but damage may occur higher in the crowns of mature lindens.

A new fact sheet about this pest is available online at **http://cecommerce.uwex.edu/pdfs/A3813.PDF**

Needle chlorosis and dieback of white spruce

– In recent years, needle chlorosis and dieback of young white spruce have been reported in central and southern Wisconsin. Though new needles appear healthy, older needles become light green to yellowish, then later turn brown and fall off. This often creates two- to three- tone color patterns of needles (Figure1). Symptoms progress over years, and branches begin to dieback. As dieback continues, the crown becomes thin and mortality could occur on severely affected trees. Needle chlorosis and dieback are observed throughout the crown with no apparent directional trend. These symptoms have been collectively described as spruce needle drop, or SNEED. A fungus *Setomelanomma holmii* has been isolated on twigs of symptomatic spruce trees and is suspected to play a role in SNEED. However, pathogenicity of this fungus on spruce has not been confirmed yet. At this point, no specific factors/pests (pathogens, insects, soil, environmental factors, etc.) that are responsible for the exhibition of symptoms referred to as SNEED have been identified, except for the fungus *S. holmii* as a potential pathogen. (See minor issues section for further information).

Figure 1. Chlorosis on older needles and new green needles give branches a two-toned appearance.

Proportion of Forest Land and Timberland

—The area of forestland in Wisconsin has been steadily increasing in recent decades and currently stands at 15.7 million acres, representing 46% of the total land area. This is an increase of almost 1 million acres since 1983. The state now has the most forest land it has ever had at any time since the first forest inventory in 1936. Wisconsin's forests are predominately hardwoods, with 84% of the total timberland area classified as hardwood forest types. The primary hardwood forest type in the state has changed from the 1930's when aspen-birch comprised 40% of timber-

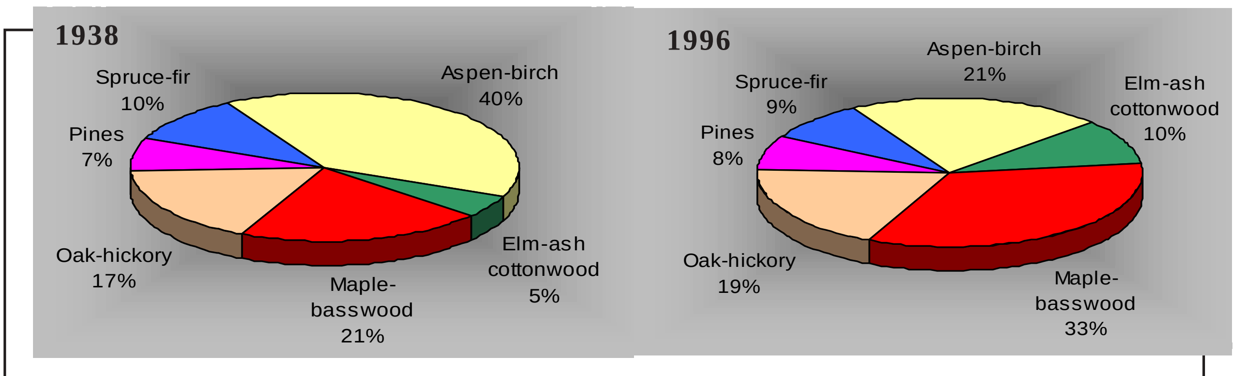


Figure 1. Percentage of timberland by forest type, 1938 and 1996. Data taken from 1938 and 1996 FIA surveys.

land (Figure 1). As our forests have aged, these types which dominated on cut-over land have been replaced by later successional species such as maple-basswood, and oak-hickory which together account for 52% of timberland acreage.

Timberland is defined as forest land that is producing, or is capable of producing, more than 20 cubic feet per acre per year of industrial wood crops under natural conditions, that is not withdrawn from timber utilization, and that is not associated with urban or rural development.

Ownership of Wisconsin's Timberland

—Individual private landowners are the largest group of timberland owners in Wisconsin, owning 57% of all timberland in 1996 (Figure 2). Counties and municipalities are the largest group of public owners, holding 15% of the total area of timberland in Wisconsin. The public owns a total of 30% of all timberland. The percentages of ownership have remained relatively constant since the forest inventory in 1956.

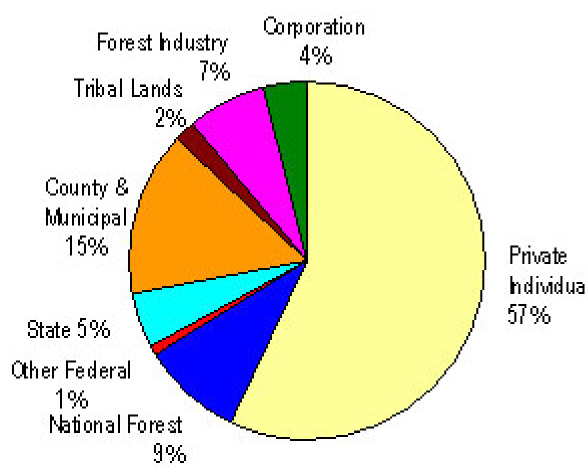


Figure 2. Forest ownership. (1996 FIA data)

Growing-stock Volume of Wisconsin's Timberland

—Growing-stock volume on timberland in Wisconsin increased from 16.5 billion cubic feet in 1983 to 18.5 billion cubic feet in

1996, reflecting an increase in both area and stocking during the 13 years between inventories. In both 1983 and 1996, hardwoods accounted for $^3/_4$ of all growing-stock volume. Acreage in seedling-sapling stands had been decreasing and acreage in sawtimber stands had been increasing since 1938 reflecting the natural aging of forests since the turn of the century. However, since 1983, the area in young forests has increased and the acreage in sawtimber has decreased, especially in stands over 120 years of age (Figure 3).

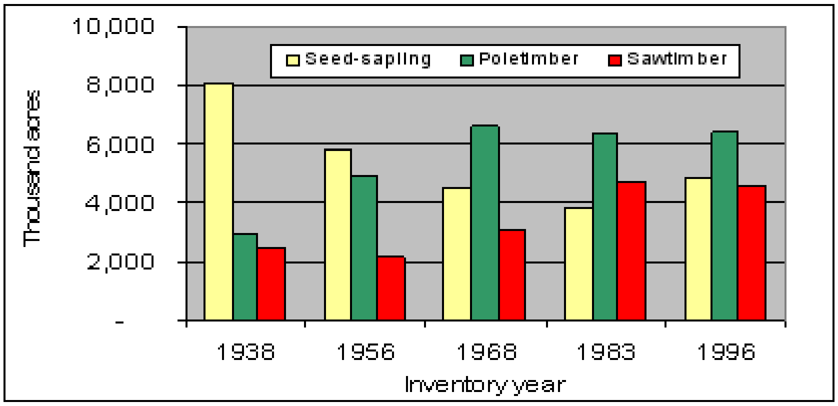


Figure 3. Acreage by size class on timberland in Wisconsin, 1938-1996. Data taken from 1996 FIA survey.

Most Common Species Groups of Wisconsin's Timberland

—The species groups with the most growing-stock were aspen, red oak, hard maple, and soft maple (Figure 4). The conifer species groups with the most growing-stock in 1996 were red pine and white pine.

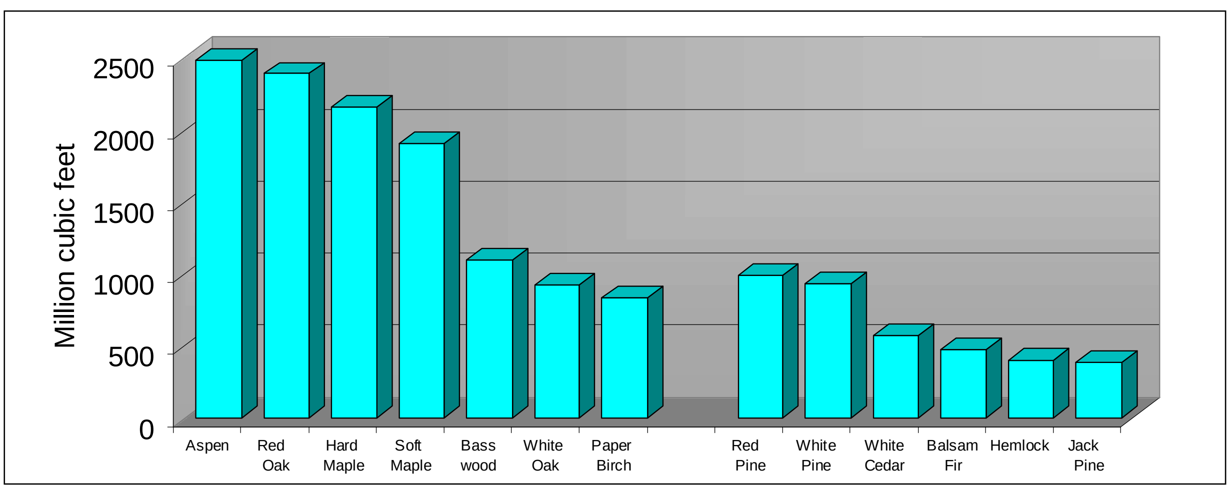


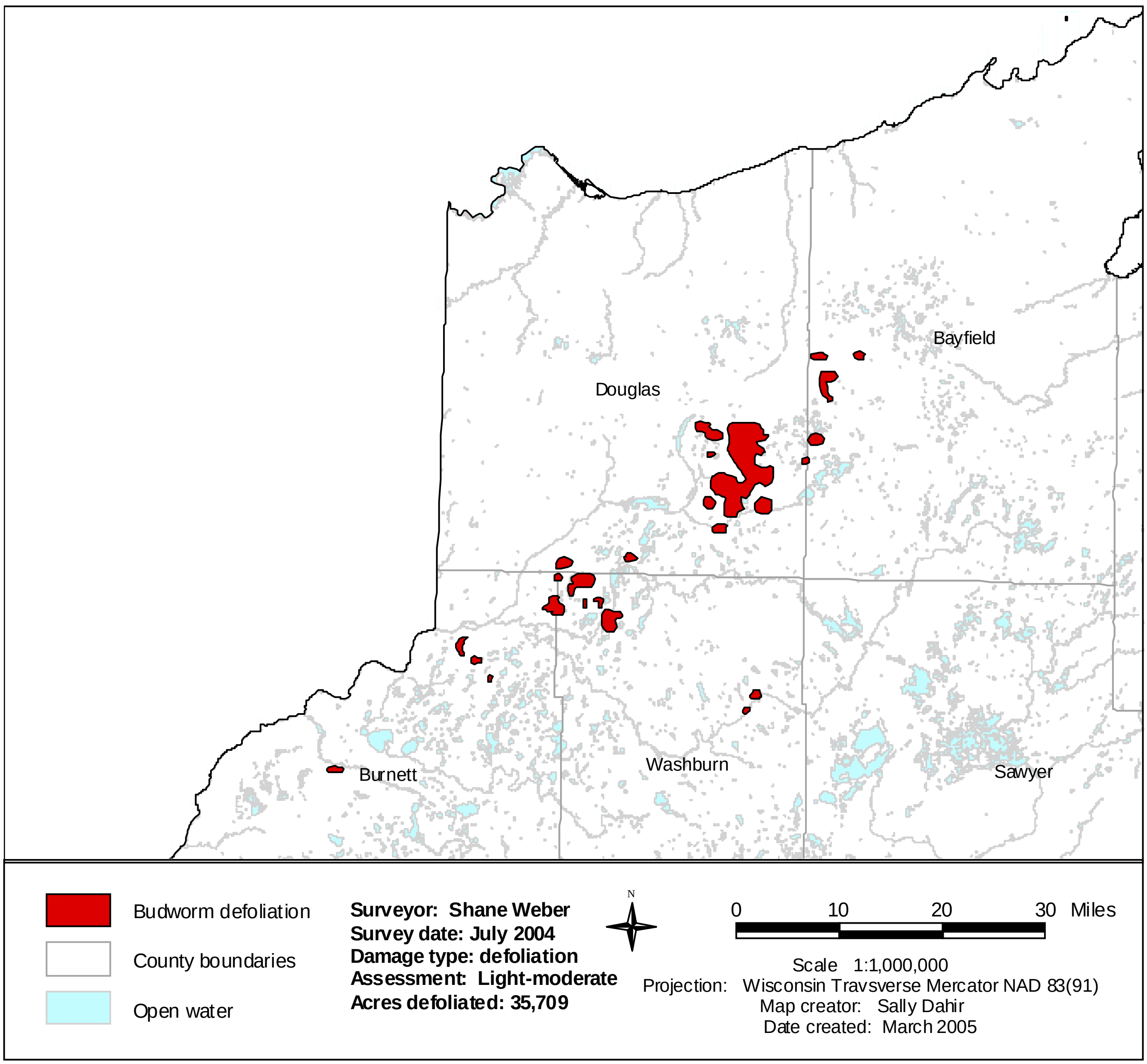
Figure 4. Most common hardwood and conifer species (in million cubic feet) on timberland in Wisconsin. Data taken from 1996 FIA survey.

Major Issues

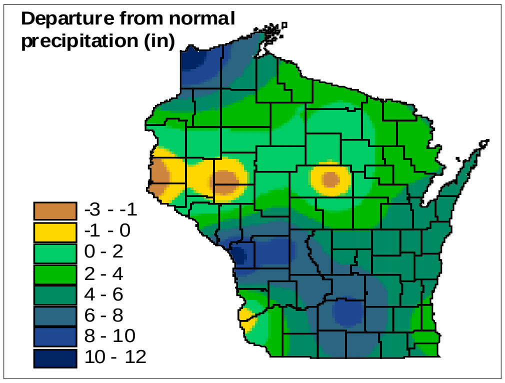
Jack Pine Budworm

Jack pine budworm *(Christonuera pinus)* populations increased across the north producing about 36,000 acres of moderate to heavy defoliation. While almost 2/3 of the defoliation occurred in Douglas County, small pockets (~40-50 acres) of intense feeding were found as far east as Vilas and Oneida counties. Population surveys indicate a high probability of a widespread outbreak (100,000 acres or more) in 2005.

In the West Central Region, the jack pine budworm population didn't increase as expected from egg mass counts in 2003, probably due to cold wet weather. However, moderate to heavy defoliation occurred in Eau Claire and Marathon counties. Populations decreased in all counties except Marathon County where moderate to heavy defoliation can be expected in 2005. In Adams County, light defoliation of red pine was thought to be due to jack pine budworm, as indicated by the type of feeding damage and pupal cases. This phenomenon has also been reported in Minnesota.



Abnormal weather in 2004: both good and bad effects



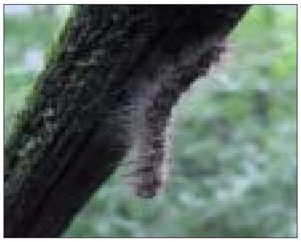
Two abnormal weather patterns in 2004 had both good and bad consequences for forest health in Wisconsin: 1) a 5-6 day period of abnormally warm weather in mid-April along with 2 days of below freezing weather in early May and 2) above normal precipitation (see map) and below normal temperatures (see table) in most of the state this summer. These departures from normal caused unusually active fungal disease problems such as aspen leaf spots, ash anthracnose, as well as a dramatic decrease in the survival of gypsy moth larvae.

	Eau Claire	Rhinel-ander	Madison	Milwau-kee
May	-3.4	-3.7	-0.5	-1.1
June	-3.1	-2.2	1.2	-2.3
July	-1.8	-2.7	-1.9	-2.8
August	-5.1	-5.5	-3.7	-3.8

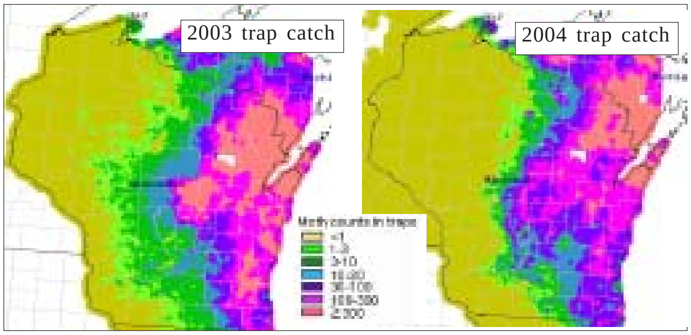
Average departure from normal temperatures for 4 weather stations in Wisconsin in 2004.

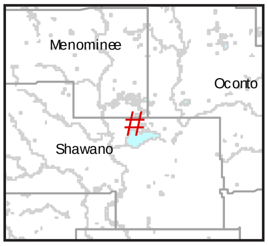
Gypsy Moth 2004

In late 2003, male moth trapping results and egg mass surveys indicated the likelihood of extensive outbreaks and defoliation in the summer of 2004 in northeastern, southeastern and central Wisconsin. Responding to this threat, communities in 20 counties applied to the suppression program. In May and early June, 51,450 acres in 311 blocks were sprayed by small plane: 46,225 acres were treated with the *Bacillus thuringiensis kurstaki* based insecticide Foray and 5,225 acres were treated with the viral insecticide Gypchek. Treatments were successful on all blocks. This success was aided by weather in May and June that was very unfavorable for the gypsy moth. Heavy and frequent storms stressed young caterpillars and encouraged mortality from *Entomophaga maimaiga* and Nucleopolyhedrosis virus. These mortality factors resulted in great decreases in the population across the state. Only 20 acres were defoliated this summer, down from 65,000 acres in 2003. This decline in the population is reflected in the male moth trapping results for 2004 (see map). In 2003, eastern and central counties had large areas where the number of males per trap were in excess of 300 (orange), indicative of a large population which could cause defoliation the following spring. In 2004, however, the area with trap catches this high had shrunk considerably. For 2005, we are expecting some defoliation in Marinette county, upper Oconto county, possibly in lower Door Peninsula in favored hosts and in the Fox River Valley cities. Scattered defoliation is possible where male moth counts are above 100 if weather and hosts are favorable.



Entomophaga maimaiga

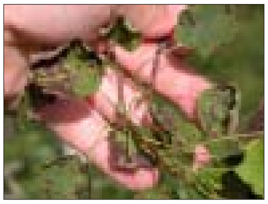




There were only 20 acres of defoliation in 2004.

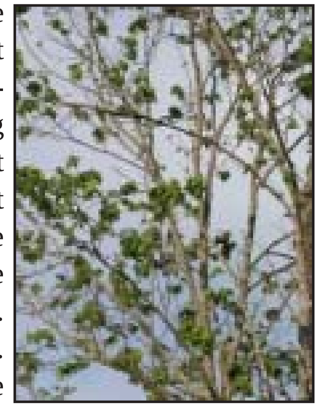
Aspen leaf spot

Frequent spring and summer rains contributed to necrosis on aspen leaves throughout the state this summer. Infected leaves showed brown flecks with yellow halos to large coalesced black blotches. Severe infection led to premature defoliation, causing crowns to appear very thin. Samples collected from Dane, Richland, Brown , and Forest counties showed infection by *Marssonina* sp. and *Phyllosticta* spp. These fungi overwinter primarily on fallen leaves. In spring, during wet conditions, spores are released and carried by wind and rainsplash to attack new leaves. This year’s wet weather allowed the fungi to continue to produce spores and infect leaves through summer. Heavily infected trees will experience growth reduction. In general, aspen is resilient to defoliation. For healthy stands, a large-scale mortality is not expected from this year’s damage. Mortality may occur on already stressed trees.

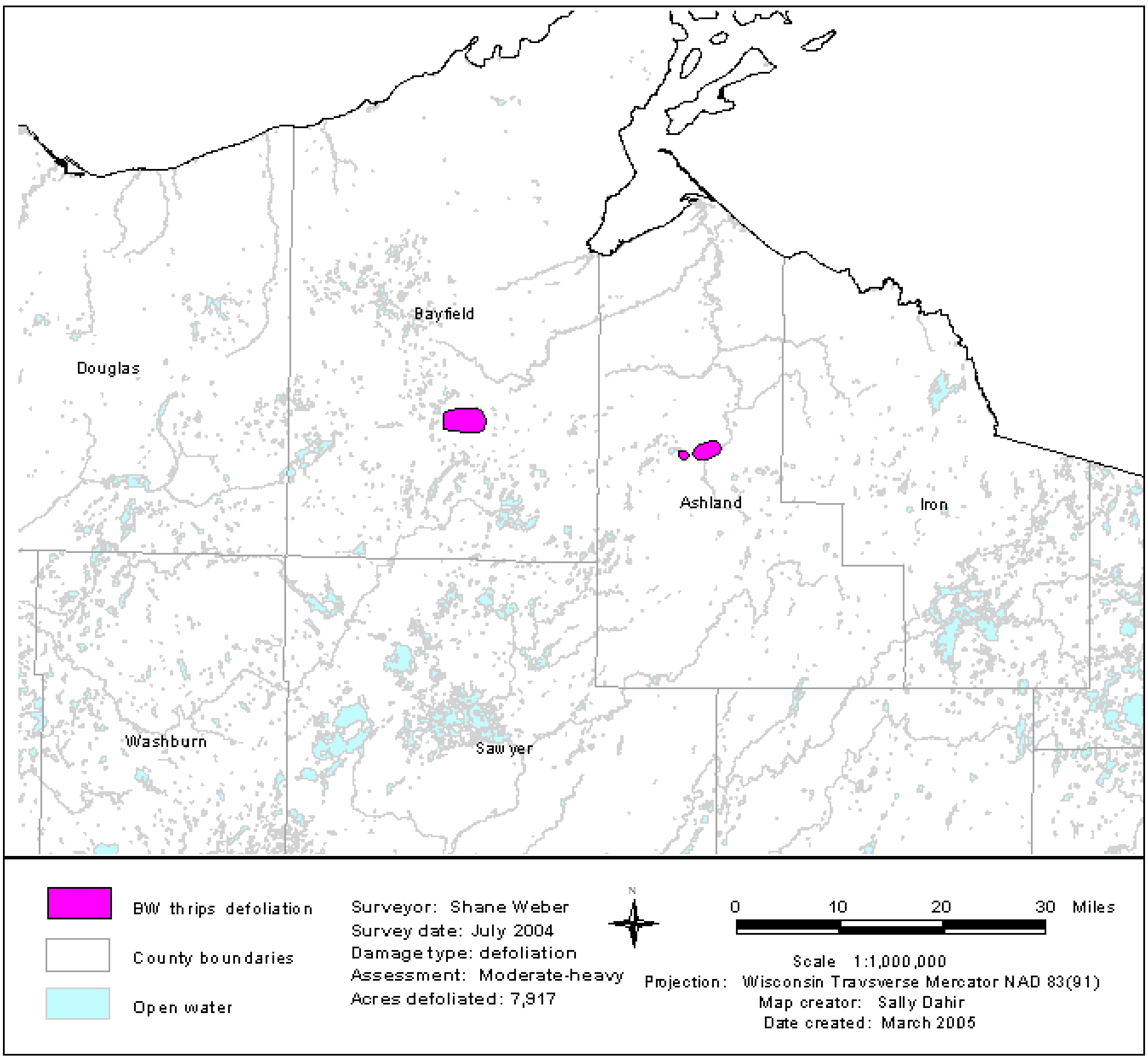


Ash leaf drop

Sparse foliage and leaf drop on ash trees was observed throughout south-central, southeastern and northeastern Wisconsin this spring. Reports often came with observations that these trees leafed out late, then developed black dead spots on leaves, and leaves started to drop, causing the crown to look even thinner. Two frost events, in early and mid-May, as well as heavy infection by the anthracnose group of fungi were the major causes of ash leaf drop. Late spring frosts can cause developing buds to be injured or die and anthracnose can cause early defoliation. Stress from last year’s drought may also have contributed to the sparse leaf-out this spring. In both 2003 and 2004, heavily defoliated trees produced more leaves in June and July but the affected trees did not show symptoms of decline for the rest of the season.



Introduced basswood thrips (*Thrips calcaratus*) feeding damage was noticeable on basswood trees in Menominee, Oconto, Marinette, Langlade, and Forest Counties. Feeding begins early in the spring inside the buds (thrips are very small critters!). When the leaves begin to expand they look like they have been frost damaged or damaged by wind (see photo). Native basswood thrips *(Neahydatothrips tiliae*) feed later in the spring and the damage is minor. There is a predatory thrips that feeds on the introduced basswood thrips but they just don't make a very big dent in the populations. From a distance basswood trees that are affected by introduced basswood thrips will have tufted foliage like the photo at right, and it can be much more severe than what's shown in the photo. These trees will attempt to send out a second set of leaves if the damage is severe. Many consecutive years of severe damage (and refoliation) can weaken the tree to the point of death.



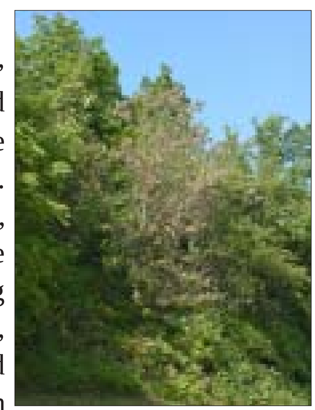
Three years of defoliation by the **Gypsy Moth**, **summer drought** and infestation by the **two-lined chestnut borer** have caused mortality of oak on approximately 2,600 acres in central Marinette County (see photo). Mortality began to occur in 2003 and continued in 2004. The average basal area of oak in this area is approximately 80 square feet/acre. Mortality is estimated to be approximately 50% of the oak or 90 trees/acre. Any one of these stress factors would not be expected to cause this level of mortality. **The coincidence of repeated defoliation and drought occurring to oak growing on well-drained soil, made the oak more susceptible to infestation by the two-lined chestnut borer.** The collapse of the gypsy moth population in 2004, followed by a return to near normal rainfall levels, should limit oak mortality in 2005.

Late-Season Leaf Discoloration of White and Bur Oak:
Drought/Tubakia Leaf Spot/Two-lined Chestnut Borer

History and Symptoms

For the past several years, the foliage on white and bur oaks in southern Wisconsin has been turning brown and shriveling up in August and September. These symptoms begin to show in the lower part of the crown and progress upward. By mid-September, a severely affected tree may appear to be dead, with no green foliage. Other trees, less severely affected, may only show symptoms on the lower half of the crown. Usually, these trees will produce foliage the following spring, yet twig and branch dieback and in rare cases mortality may occur.

Potential Causes



Observations over the past three years have revealed the presence of a leaf spot fungus, *Tubakia dryina*. This fungus has been detected on oak in Wisconsin for many years and can infect all of Wisconsin's native oak species. Typically, Tubakia does not cause significant damage to a tree but does give the tree a "sick" or "unthrifty" appearance. Coincidentally, Wisconsin has been experiencing a drought during the summers of 2001, 2002 and 2003. This drought compromised the health of many trees, including the white and bur oaks. The two-lined chestnut borer, *Agrilus bilineatus*, has been found infesting the top branches of white and bur oaks affected by Tubakia. The combination of drought, Tubakia and two-lined chestnutborer has overcome some of these oaks and caused mortality. Mortality has not been common but has been observed on ridgetops and south and west facing slopes with shallow soils (photo on right).

Biology and Management

Tubakia overwinters on infected twigs and leaves. During the summer, spores are produced on this infected material and are spread by wind and rain. Removing and destroying fallen infected leaves may reduce the amount of spores at the local level and be an option for disease management for a yard tree. During the growing season, water oak trees during prolonged dry periods. In the forest, follow forest management practices that reduce stress and favor vigorous crown development. This will minimize the effects of both Tubakia and the two-lined chestnut borer. Controlled burning will destroy infected leaves on the ground and reduce the local source of inoculum but this disease is so widespread in the forests of southern Wisconsin the impact of reducing disease through local control is unknown.

Annosum Updates 2004

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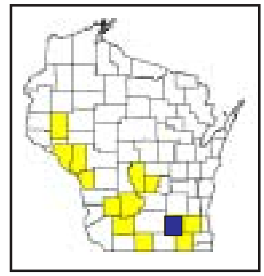
Plant Pest and Disease Specialist and State Forest Pathologist
Wisconsin Department of Natural Resources
Fitchburg WI

Annosum root rot - *Heterobasidium annosum*



Confirmed counties with annosum present

Jefferson County (in blue on map) was added to the list of Wisconsin counties confirmed with annosum present. The confirmed site in Jefferson County is located near the border of Jefferson and Waukesha Counties (Sec.24, T8N, R16E). This brings the total to 13 counties (Adams, Buffalo, Dunn, Green, Iowa, Jefferson, La Crosse, Marquette, Richland, Sauk, Trempealeau, Walworth, and Waukesha counties).

Annosum Biocontrol Update

The Sauk County Forest has been the site of on-going research related to the control of annosum root rot. Freshly cut stumps just outside the perimeter of known annosum infections were treated with the bio-control fungus, *Phlebiopsis gigantea*, to prevent root to root spread of annosum root rot from infected stumps to adjacent healthy stumps and trees. Detailed methods and results of previous work can be found in the masters thesis by Crystal Floyd, "Biological Control of Root Rots in Forests Using Fungi", University of Minnesota, December 2002. Additional information on the Sauk County Forest research can be found in previous issues of "Forest Health Conditions in Wisconsin" (WI DNR 2000, 2001, 2002, and 2003).

In the winter of 2004, the biocontrol treatment sites and surrounding areas were evaluated for disease expansion and new infection centers. A total of 14 positive annosum infections were detected:

6 infections: uncertain if initiated from thinning stumps that occurred during the start of this trial or may have been infected prior to biocontol trials and just now showing symptoms.
4 infections: appear to have started directly from thinning stumps created at the start of this trial. These stumps were in the sporax treatment area and should have been protected from new infections. It is not certain if these stumps were missed and not treated with Sporax, or these stumps were indeed treated with Sporax but treatment did not provide enough protection.
2 infections: were present but previously unconfirmed annosum "pockets" prior to biocontrol trials.
2 infections: were detected in 2003 and likely present prior to biocontrol work.

Because four annosum infection centers were likely initiated as part of thinning operations conducted in conjunction with biocontol trials, even though these stumps were apparently treated with Sporax*, a follow-up survey of a Sporax treated white pine thinning was conducted. The objective of this survey was to determine if the Sporax treated stumps were indeed being protected by treatment. This Sauk County Forest stand was thinned in 1999 and all stumps were treated with Sporax. No annosum was detected in this white pine plantation with one exception. On the very southern end of this plantation, a few rows of mixed red and white pine were planted. In this area one new .annosum infection center was detected on both red and white pine.

*Sporax has been used successfully to prevent establishment and growth of *Heterobasidon annosum* in cut stumps of conifer tree species that are **not** already infected. Sporax is a product currently registered by the EPA for this use in Wisconsin. **Stumps must be treated as soon as possible but no later than one day after cutting.** Sporax is typically applied from a container with a perforated lid. One pound will cover 50 square feet of stump surface. This is equivalent to 260, 6-inch (15 cm) diameter stumps or 60, 12-inch (30 cm) diameter stumps

To further assess the efficacy of Sporax and biocontrol treatments, these biocontrol trial sites and surrounding areas will continue to be monitored for the development of the disease.

Annosum Planting Trial

In November of 2003, approximately 13 acres of the Sauk County Forest were clearcut (photo on left) as a salvage operation due to extensive Annosum root rot infection. A management plan has been developed which includes prescribed burning to reduce spore load and conducting a planting trial. Stumps have been painted and tagged to delineate infection perimeters. The clearcut has been divided up into "burn and no burn" sections. Within these sections, several hardwood and conifers species will be planted to evaluate long-term survival where Annosum root rot has been found. Initial site prep and brush clearing were completed. A fall 2004 burn was conducted but results were poor (photo on right). A spring 2005 burn will be attempted before planting. In addition to reforesting the clearcut, there will be higher density short-term plots established within this area to monitor seedling survival. Planting is scheduled for the spring of 2005.

Annosum Management Recommendations

A publication comparing annosum root rot with red pine pocket mortality can be observed at www.dnr.state.wi.us/org/land/forestry/fh/fhissues/annosum.htm. This publication outlines symptoms/signs and management recommendations. For a copy, email: jane.cummings-carlson@dnr.state.wi.us or call 608-275-3273.

Oak wilt Suppression Cost-share Program in 2004

Kyoko Scanlon, Forest Pathologist
Fitchburg, WI

In 2004, the Wisconsin DNR received a one-time federal cost-share grant from the USDA Forest Service to control the spread of oak wilt in private woodlands. The funding was incorporated as part of the Stewardship Incentive Program (SIP) Health grant, and $50,000 was allotted for oak wilt suppression efforts. This was the first oak wilt suppression program that the Wisconsin DNR offered to private landowners in Wisconsin.

The grant was established to reimburse 65% of the costs associated with root severing treatment to stop the underground spread of oak wilt. Eligible practices included oak wilt laboratory diagnosis, trench-line layout, trenching (see photo on right), and tree removal after trenching. This funding did not allow other oak wilt control measures, such as herbicide applications to create a barrier (instead of trenching) or fungicide applications to protect individual trees.

To be eligible for this program, a landowner had to meet the following criteria;

- The property where a treatment would be conducted was located in the following counties;

  Adams, Buffalo, Clark, Columbia, Crawford, Dane, Grant, Green, Iowa, Jackson, Juneau, La Crosse, Lafayette, Marathon, Monroe, Richland, Sauk, Trempealeau, Vernon, and Wood counties (20 Counties).
- The property where a treatment would be conducted had a Landowner Forest Stewardship Plan.
- The property where a treatment would be conducted was at least 10 contiguous acres of non-industrial private forest, but not more than 500 acres of forested land within Wisconsin.

An information packet was created in April, and distributed to interested private landowners. The packet included application forms, step-by-step planning guidelines, a list of tree care professionals, and a variety of brochures that described oak wilt biology and management. Information on this grant opportunity was given to DNR foresters and private consulting foresters through e-mails, Forestry Forum, and/or regular mail. It was also advertised to the public through regional news releases. The deadline for submitting an application for this program was July 10, 2004. All work had to be completed and paperwork submitted by September 30, 2004.

Two applications were received, approved, and reimbursed for 65% of the applicable expenses. One property was in Richland County with 3 oak wilt pockets, totaling 1.8 acres. The other property was in La Crosse County with 2 oak wilt pockets, totaling 1.25 acres. Both sites were inspected and approved for the soundness of the treatment by the forest pathologist prior to reimbursement.

The limited use of this program, despite the advertising efforts and a large number of inquiries received through phone calls and e-mails, was an issue. Some of the limiting factors for many of those who contacted for more information were that they were not eligible for this program for the following reasons.

- Oak wilt infected trees were yard trees
- Landowners did not have a Stewardship plan
- Their property was not in one of the 20 counties that had been specified by the grant.

A follow-up survey was conducted to landowners and foresters who requested an information packet, in an attempt to learn more about the perception of the program and other limiting factors that made them decide not to apply for the program. The survey asked the following questions.

1. Did you receive all the information you needed from the packet?
2. Was the information in the packet easy to understand?
3. (For landowners) If you applied for this program, were you satisfied with the program? (For foresters) If the landowner that you thought may benefit from this program applied for the program, was he satisfied with the program?
4. (For landowners) If you didn't apply for this program, what was/were the limiting factors for you to decide not to utilize this program? (For foresters) If the landowner who you thought may benefit from this program didn't apply for the program, what was/were the limiting factors for the landowner not to utilize the program?
5. How do you think we can improve this program?

Six foresters and four landowners returned the survey. They all agreed that they received all the information they needed from the packet, and the packet was easy to understand. A landowner who was granted for the program answered that the program was very satisfactory. When a landowner decided not to participate in this program, limiting factors that were listed were as follows.

- The site was too steep to conduct root graft severing (2)
- There were too many oak wilt pockets to make root graft severing effective (2)
- It was too late to apply for the program (1)
- It was too expensive to conduct root graft severing even with the reimbursement (3)
- The landowner didn't want to pay all the cost up front (1)
- The quality of the oak resource was not worth the expense of trenching (1)
- The landowner was doubtful that root graft severing would be effective. She heard from another landowner who tried it that it did not work. I suspect they had not done the trenching properly. (2)
- It was too much bother for a landowner (1)
- The landowner was not sure of total cost over 160 acres (1)

The comments to the question how we can improve this program, were as follows.

- More opportunity to apply (longer time window).
- More advertising of the availability of the program.
- With your materials, include trenching success stories.
- It might be better if the DNR handled all the work and contracting.

Though we had a limited number of applications in 2004, we learned much about the public's interests in oak wilt management through offering this program, and also through the follow-up surveys. We will utilize the knowledge and experience that we acquired through this program for oak wilt suppression programs that may become available in the future.

Oak Wilt Marathon County Control Trial

2004 Updates on the herbicide trial in the Nine-Mile Recreation Area on the Marathon County Forest

Kyoko Scanlon, Forest Pathologist,
Fitchurg WI

Background

Oak wilt is a serious disease of oak, caused by the fungus, *Ceratocystis fagacearum*. The fungus attacks a tree's water and nutrient conducting system, and effectively kills the tree. The disease spreads from diseased to healthy trees through insects and through root grafts. The use of a vibratory plow to break root connections has been a recommended practice to stop the underground spread of oak wilt. When correctly performed, this practice can be very effective. However, a vibratory plow is often impractical or inoperable in some stands with steep terrain and with large boulders or hardpans. If an infection site is remote from an access road, a vibratory plow may not be a practical option.

The idea of creating a barrier using herbicides is a relatively new approach, and has been tested in the field where a vibratory plow is not a viable option. In this practice, infected trees and apparently healthy trees within a certain distance from infected trees are treated with herbicides in an attempt to kill both above and below ground portions of these trees. The complete death of the root system would stop the movement of the fungus, thus would act as a barrier. Preliminary results from other states have shown some success in killing above ground portions in a timely manner, but not the below ground portions. These studies were conducted at several different times of year, but not in June to early July, when oak trees are most actively growing. Applications of herbicides during June and July appear to bring rapid mortality of treated trees, which may induce root deterioration/mortality more effectively.

A herbicide field trial was initiated in the Nine-Mile Recreation Area on the Marathon County Forest in 2003 after two oak wilt sites were found in late summer 2002. Trees within grafting distance were identified by using Johann Bruhn's model, and these trees were treated with Garlon 4 (active ingredient: triclopyr) in early July 2003 (for the details of the treatment in 2003, please refer to an article, titled "Herbicides as a Treatment to Limit the Underground Spread of Oak Wilt, Annual Report 2003, page 12). Since the initial treatment, the progress has been closely monitored, and some follow-up treatments were conducted in 2004.

Treatment in 2004

In August 2003, two trees (one single tree that was in between the two originally infected trees and one double oak tree) that were outside the treatment area were found infected with oak wilt in one site. It is believed that these two trees missed treatment in 2003 due to slight miscalculations in the original treatment. Trees within grafting distance from these two trees, which accounted for 20 additional trees, were again treated with Garlon 4 in early July 2004. In 2004, a more aggressive approach was adopted by using Johann Bruhn's model for sandy soil. One out of the 20 trees that did not show wilting symptoms after the initial application in early July was re-treated in late July. By the end of July, all treated trees appeared to be completely dead. The sites were monitored for the rest of the growing season, and no additional symptomatic trees were found. In the fall 2004, all trees that were treated in July were harvested and removed from the site.

Plan for 2005

The sites will continue to be monitored through weekly visits by county forest personnel during the summer of 2005.

Unknown Butternut Mortality

—In early June, Green County forester, Ray Amiel, reported a young (~8 years old) plantation of butternut trees, just east of New Glarus, failing to leaf out. Symptoms were indicative of winter injury. At the time of the initial visit, there was little if any flush of leaves (Figure 1). The forest health staff visited the site in early July at which time many of the trees had developed some new growth on the inner portions of the crown (Figure 2). The distal 2'-3' of many branches still had not flushed and many were dead. Dead branch samples were taken back to the lab and numerous branches had what appeared to be extensive weevil like feeding just below the terminal buds (Figure 3). The butternut curculio (*Conotrachelus juglandis*) was suspected and a follow up visit was conducted in mid September to look for damage by this insect. No evidence of damage by this weevil was found and the butternut trees looked like they were recovering nicely (Figure 4). In addition to the branch dieback a few cankers indicative of butternut canker were observed and may pose a threat to this plantation in the future. Adjacent black walnut did not experience the late flush and had only minor tip dieback on a few branches. Report any similar flush and branch dieback symptoms to your forest health specialist.

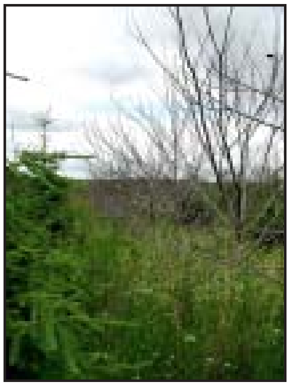


Figure 1. Butternut trees failed to leaf out in the spring

Figure 2.In July there was new growth but many dead branches.

Figure 3. Evidence of weevil feeding below the terminal buds.

Figure 4. Butternut trees show good recovery in September

Recommendations to the landowner were to let the trees continue to grow and follow the 70-20-50 rule regarding butternut retention as described in “Butternut-Strategies for Managing a Threatened Tree” (USDA Forest Service). Retain all trees with more then 70% live crown and less then 20% of combined circumference of the bole and root flares affected by canker. Retain all trees with at least 50% live crown and no cankers on bole or root flares.

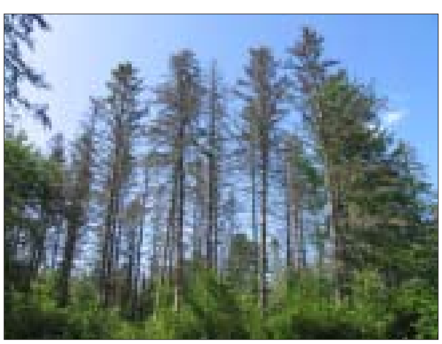
For more information on butternut management go to:

http://www.ncrs.fs.fed.us/pubs/gtr/gtr_nc165.pdf

http://www.na.fs.fed.us/spfo/pubs/howtos/ht_but/ht_but.htm

Spruce Mortality

—Mortality of white spruce was observed in 2003 on approximately 3,800 acres on the Chequamegon National Forest. Spruce in several of these plantations has shown signs of poor vigor since the late 1980’s. These signs include poor diameter growth and premature needle loss on the lower and inner portion of the crown. Investigations by the USDA Forest Service have shown that the 2002-2003 summer drought including the recent defoliation by the spruce budworm in 2003 and 2004 have likely played a significant role in the mortality. The fungus, *Setomeloanomma holmii,* has also been observed on the twigs and foliage of some of the affected trees. The role of this fungus is unknown; it has been associated with spruce needle drop or SNEED.

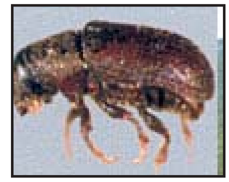


Large Aspen Tortrix

—Large Aspen tortrix *(Christoneura conflictana)* produced tens of thousands of acres of aspen defoliation. Pockets of moderate to near total defoliation ranging in size from 100 to 2,000 acres were scatterred across the entire northern part of the state. Unfortunately, this is occurring just as aspen is recovering from forest tent caterpillar. Growth reductions will probably occur as a result of this defoliation.

Eastern larch beetle

—Eastern larch beetle (*Dendroctonus simplex LeConte*) is a native bark beetle that attacks larch/tamarack (*Larix laricina* (Du Roi) K). The adult beetles aggregate on standing and fallen trees or stumps, tunnel through the bark, and feed and mate in the phloem. These insects are great woodpecker food and the woodpeckers spent many hours throughout last winter peeling the bark off infested tamarack trees (see photo on left). Tree mortality from eastern larch beetle is a widespread issue across Wisconsin as well as northern Minnesota at this time. Relatively healthy trees can be attacked and killed by this beetle, and since 1970 extensive outbreaks have been recorded throughout North America.If you think you might have problems with eastern larch beetle and need more information check out the forest service publication at http://www.na.fs.fed.us/spfo/pubs/fidls/elb/elb.htm .



Cedar tree borer

—This longhorned beetle *(Semanotus ligneus)* prefers weak, damaged, or recently cut trees. It's preferred host is cedar (red and white) but it will attack other species including cypress, juniper, and sequoia. The young larvae start their life by boring under the bark in the cambium layer but will later bore into the wood of the tree, chewing holes/tunnels as they go. If you build a cabin with cedar logs that are not peeled you may have trouble with this insect attacking your logs. The photo at right shows the larvae and some of the damage to the cambium layer.

Sirococcus shoot blight

—Sirococcus shoot blight is caused by the fungus, *Sirococcus conigenus*. The fungus attacks various conifers in the Northern United States and southern Canada, by infecting new shoots. Serious damage has been observed on red pine in the Lake States. In Wisconsin, affected conifer species include red pine, Colorado blue spruce and white spruce. An infection on balsam fir was reported in Marinette County. The map on the left illustrates the counties where sirococcus shoot blight has been observed in Wisconsin.

Needle chlorosis and dieback of white spruce

In 2004, three sites that exhibited needle chlorosis and dieback of young white spruce were visited by forest health specialists. These sites were located in Fort Atkinson, Jefferson County, Dorchester, Clark County, and near Junction City, Portage County. The trees were approximately 8-15 years of age. The white spruce trees were planted, occasionally mixed with fir. Roots of severely affected trees were excavated to look for root damage. However, no apparent damage, decay or discoloration, or signs of infection by root rot fungi were observed on their

Roots showed no sign of damage or rot.

roots (see photo). No apparent insect feeding was observed on needles, branches, or stems. Foliage and soil samples were taken for further analysis.

Microscopic examinations of twig samples revealed the presence of *S. holmii* black ascomata with abundant ascospores on twigs for samples from all of the three sites. Fruiting bodies of *S. holmii* were found on both twigs with symptomatic needles and twigs with non-symptomatic needles. Ascospores of *S. holmii* were prominent in May and June, then decreased in numbers dramatically by July. Some needles were also lightly infected with *Rhizosphaera kalkhoffii*, however this pathogen was not considered to be the main cause of SNEED due to the low level of infection.

Foliage analysis was also conducted by the University of Wisconsin Soil & Plant Analysis Lab for nutrient analysis. Symptomatic and non-symptomatic one-year-old needles were collected for this analysis. Foliage analysis revealed that some of the nutrients in the sample foliage were out of the normal survey range of white spruce. For example, the levels of manganese and nitrogen were lower than the normal range for white spruce, and this trend was more prominent on symptomatic samples. Three non-symptomatic samples from Fort Atkinson exhibited higher levels of calcium than the normal range for white spruce. The soil pH varied from 6.3 to 7.5, though there was no significant difference between non-symptomatic and symptomatic areas within a site.

Although abnormal levels of certain nutrients/micronutrients were detected, the data are not sufficient to attribute all the symptoms to nutrient deficiency. More sample collection and analysis of soil and foliage data should be conducted to further investigate the relationship between concentrations of certain nutrients/micronutrients and the health of white spruce. The fact that the fungus *S. holmii* was sporulating prominently in May and June implies a possibility that this fungus plays a role in various SNEED symptoms. However, the level of contribution, if any, is uncertain until its pathogenicity is proven. The University of Wisconsin, Department of Plant Pathology has been investigating the pathogenicity of *S. holmii*. Colorado blue spruce and white spruce seedlings were inoculated with this fungus in 2002 and these seedlings have been monitored for the development of disease symptoms. The DNR will continue to investigate the development and spread of various symptoms in the field by re-visiting these three sites in 2005.

White pine dieback and mortality - unknown

In 2004, dieback and mortality of large sapling to pole timber size white pine were observed in two sites in Wisconsin. There were similarities and differences in the symptom development between the two sites. On a tree farm near Algoma (Kewaunee-Door Co. border), dieback symptoms appeared to have started from the lower crown and progressed upward, though some trees had top dieback (Figure-1). Some of the trees were completely dead with brown needles. Others had thin crown with chlorotic, tufted needles. In a plantation near Platteville (Grant Co.), needle chlorosis was scattered throughout the crown (Figure 2, next page). In both sites, affected trees were scattered throughout the areas where this problem was observed, instead of creating distinctive pockets of dead and dying trees. In either of the sites, no apparent insect feeding or pathogens were detected on needles.

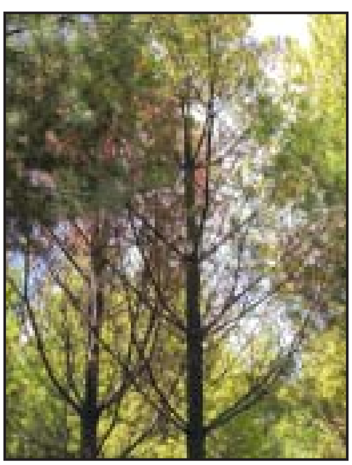


Figure 1. Top dieback occurs on some white pine.

On the Algoma site, resin flow from flush-cut pruning scars was prominent on many of the trees (Figure 3, next page). However, we did not consider pruning to be the major factor of the dieback because dieback symptoms were observed both on pruned and non-pruned sites. Poor pruning may be playing a role in weakening trees. Depression and discoloration on the main stem was observed, frequently with a small amount of resin flow and brown discoloration on wood behind the bark. However, no apparent canker-causing pathogens were isolated from wood and bark samples, except for one sample that contained tendrils of possible *Cytospora* spp. and one sample with *Fusarium*-like sporodochia.

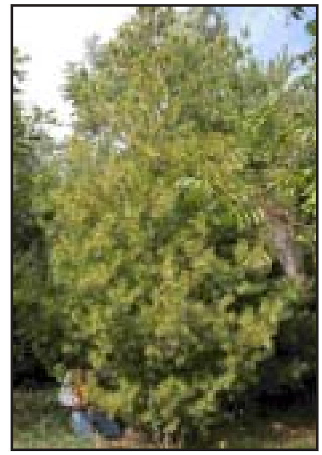


Figure 2. Chlorosis may be scattered throughout the crown

Soil and foliage samples were also collected from the Algoma site in December for nutrient analysis. The analysis was conducted by the University of Wisconsin Soil & Plant Analysis Lab. Preliminary results of nutrient analysis from foliage samples showed that some of the nutrients in the foliage were out of the normal survey range of white pine. The nutrients that were low in the foliage included Manganese and Calcium. Though these nutrients were low in the foliage, the soil collected from the same areas contained average concentrations for these nutrients. Soil pH ranged from 6.9 to 7.5. This was higher than a suitable pH range for white pine growth (pH 5.5-6.5).

Figure 3. Many trees had resin flow from pruning scars.

Infestations by the bark beetle, *Pityogenes hopkinsi*, were commonly found with dying and dead trees. *P. hopkinsi* attacks already weak trees and shaded branches of pine, most commonly eastern white pine. Pitch tubes from the red turpentine beetle (*Dendroctonus valens*) and feeding damage of the root collar weevil (*Hylobius radicis*) were observed at the base and around root collar areas of dying trees on pruned and non-pruned sites. Resin flow at the base of these trees was also seen, and wood under the bark was often chocolate brown and soaked with resin. Wood samples were collected from root collar areas, and *Leptographium* spp. was isolated from 2 out of 4 samples in the pruned site. *Leptographium* spp. was not confirmed from wood samples collected from the non-pruned site.

Figure 4. Wood under bark was resin-soaked.

Leptographium spp. was also isolated from 1 out of 3 wood samples that were collected in the Platteville site. Resin flow was prominent at the base of the trees with chlorotic crown (Figure 3). Wood under the bark was soaked with resin and discolored extensively (Figure 4). *Leptographium* samples both from Algoma and Platteville sites were given to the University of Wisconsin, Department of Plant Pathology (Dr. Glen Stanosz) for species identification by genetic sequencing. Though certain species of *Leptographium* are considered pathogenic, others are regarded as saprophytes or only weak pathogens. It is important to have these *Leptographium* strains identified to species in order to help determine the role of *Leptographium* spp. in the symptoms that we have been observing. A pathogenicity test of these collected strains would be an ideal next step, if funding would become available to support such a project.

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Pest	Host	Damage	Location
Abiotic			
Herbicide Damage (cut stump treatments)	White Spruce, White Pine, and Tamamrack	Exaggerated growth, needle chlorosis, and tree mortality. Trees have been dying since the TSI work was done in 2001.	Vernon County
Winter freeze/drought	All conifers (Fir, Pine, Spruce, etc.)	Conifers still showing damage and trees continue to die.	Scattered throughout West Central Region and Waupaca County.
Ash			
Anthracnose *(Gnomoniella fraxini)*	Ash spp.	Necrotic lesions on foliage with some premature leaf fall	Scattered statewide, diminished in the northwest
Ash bark beetle *(Hylesinus spp.)*	Ash spp.	Dead ash	Door, Grant, Kenosha, Marathon and Juneau County.
Ash borer *(Podosesia syringae)*	Ash spp.	Girdles tree vascular system	Door County.
Ash flowergall mite (Aceria fraxiniflora)	Ash spp.	Distorts male flower clusters	Fond Du Lac County.
Ash leaf drop: Cause unknown	Ash spp.	Black spots on leaves and severe defoliation (leaf drop) in late May	Scattered throughout SCR & SER, Brown, Oconto, Door, Kewaunee, Manitowoc, Outagamie counties
Ash plant bug *(Tropidosteptes amoenus)*	Green, white ash	Heavy stippling with much leaf drop	Washburn and Bayfield counties
Ash yellows *(Phytoplasmalike organism)*	Green, white ash	Overall ash decline	Grant County.
Ashleaf gall mite *(Aceria chrondriphora)*	Ash spp.	Only drawbacks are aesthetically	Scattered statewide
Drought stress	Ash spp.	Thin crowns with tufted foliage	Scattered statewide
Frost damage	Black ash	Injuries to fine root system	Douglas County.
Mountain ash sawfly *(Pristiphora geniculata)*	Mountain ash	Partial defoliation	Door County; diminished in Washburn Cty
Redheaded ash borer *(Neoclytus acuminatus)*	Ash sp.	Girdles tree vascular system	Juneau, Door County.
Aspen			
Aspen leaf spot *(Marssonina spp. Phyllosticta spp.)*	Aspen	Leaf necrosis, defoliation	Scattered throughout the state
Blotch Miner *(Phyllonorycter spp)*	Aspen	Moderate mining, some crown discoloration	Moderate in Vilas, Oneida and Price counties
Balsam Fir			
Spruce Budworm *(Choristoneura fumiferana)*	Balsam fir	Defoliation	Door County.
Basswood			
Introduced basswood thrip *(Thrips calcaratus)*	Basswood	Light to moderate defoliation	Oconto, Menominee, Shawano, Marinette, Forest, Langlade counties.
Linden Borer *(Saperda vestita)*	linden	Girdling	Brown, Outagamie counties

Pest	Host	Damage	Location

Birch

Bronze birch borer *(Agrilus anxius)*	White birch	Light, scattered defoliation	Decreased in northwest

Butternut

Butternut canker *(Sirococcus clavigignenti-juglandacearum)*	Butternut	Stem cankers and mortality	Marinette County.

Cherry

Black knot *(Apiosporina morbosa)*	Black, pin, choke cherry	Prevalent	Sawyer, Price, Barron, Washburn, Polk counties
Eastern tent caterpillar *(Malacosoma americanum)*	Black cherry	Moderate to heavy defoliation	Dane County.
Forest tent caterpillar *(Malacosoma disstria)*	Cherry	Moderate defoliation	Decreased in northwest; Remant populations in Burnett & Polk counties
Peach bark beetle *(Phloeotribus liminaris)*	Cherry	Infestation on large saplings	Sauk County.

Chestnut

Chestnut blight *(Endothia parasitica)*	American chestnut	Dieback, mortality	Richland County.

Elm

Dutch elm disease *(Ophiostoma ulmi)*	Elm	Tree mortality	Scattered throughout the West Central region and Northern counties
Fall webworm *(Hyphantria cunea)*	Elm	Minor defoliation	Decreased in northwest and north central counties

Hickory

Hickory Bark Beetle *(Scolytus quadrispinosus)*	Hickory spp.	Crown dieback leading to tree mortality.	Dane, Clark and Vernon counties
Phomopsis Gall *(Phomopsis spp.)*	Hickory spp.	Galls on branches causing some branch dieback	Shawano, Clark and Vernon counties

Maple

Anthracnose *(Gloesporium apocryptum)*	Red & sugar maple	Very heavy leaf spotting	Scattered throught SCR and SER, much less in Northwest
Fall webworm *(Hyphantria cunea)*	Many hardwoods	Webbing of branches and light defoliation	Scattered throughout the West Central Region and Shawano, Marinette counties
Gouty vein midge *(Dasyneura communis)*	Maple	Leaf distortion	Green County.
Maple dieback: cause unknown	Sugar maple	Top dieback and mortality	Lincoln County.
Maple petiole borer *(Caulocampus acericaulis)*	Sugar maple	Leaf drop	Shawano County, Increased in Sawyer County
Tar Spot *(Rhytisma spp)*	Silver Maple	Leaf damage	Scattered throughout the West Central Region and Manitowoc County

Pest	Host	Damage	Location

Miscellaneous Pests

Multicolored Asian Lady Beetle *(Harmonia axyridis)*	Homes	Nuisance	Scattered throughout the West Central Region, Brown, Waupaca, Manitowoc counties

Oak

Anthracnose *(Apiognomonia spp.)*	Oaks	Browning and curling of infected leave. Premature leaf drop.	Scattered throughout the west central, south central and southeast regions, and Waupaca County, Decreased in Washburn County
Bacterial wetwood (species unknown)	Oak	Bleeding canker	Vernon County.
Botryosphaeria canker *(Botryosphaeria dothidea)*	Red & Northern Pin Oak	Branch tips dead	Northwest and North Central counties, Waupaca, Waushara, Green Lake counties
Columbia timber beetle *(Corthylus columbianus)*	Oak	Bleeding canker	Dane County.
Cynipid Wasps *(Family Cynipidae)*	oak	Leaf curl	Brown County.
Hedgehog galls *(Acraspis erinacei)*	White oak	Spongy round galls on leaves, leaf drop	Dane and Washburn counties
Iron Deficiency	Oak, especially northern pine & white oaks	Light green to yellowish leaves with green veins	Scattered throughout SCR and SER
Jumping oak gall *(Neuroterus saltatorius)*	Oak	Seed-like galls on leaves	Dane County.
Kermes scale *(Kermes spp.)*	Oak	Twig dieback	Northwest and North Central counties, Green County.
Leucanium scale *(Leucanium spp)*	Oak	Twig dieback	Green County.
Oak leaf roller *(Archips spp.)*	Oak	Rolled leaves and defoliation	Dane County.
Oak tatters: Cause unknown, spring frost is a suspected factor	White and bur oak	Severely tattered leaves and defoliation	Scattered throught SCR and SER, especially Dane, Green, Jefferson, and Rock counties.
Oak Wilt *(Ceratocystis fagacearum)*	Red Oak spp.	Tree mortality. Found fresh pressure pads (fungal mats) and beetles on recently killed oaks on 28 September in Portage County.	Scattered throughout the west central, south central and southeast regions, Marinette, Oconto, Waushara, Marquette, Green Lake counties, Slow spread to Grantsburn and Marshland townships in the NW Region
Orange-striped oakworm *(Anisota senatoria)*	Red oak	Localized heavy defoliation on small sapling	Dane County.
Tubakia leaf spot *(Tubakia dryina)*	Oak	Leaf spot and defoliation	Southern Wisconsin
Twolined Chestnut Borer *(Agrilus bilineatus)*	Oak	Girdling and tree mortality	Oconto, Waupaca Florence, Marinette, Oneida and Portage counties, way down in Northwest Region

Pine

Annosum root rot *(Heterobasidion annosum)*	Red pine	Tree mortality	Jefferson County.
Armillaria root rot *(Armillaria mellea)*	Jack, Red, Scotch, and White Pines	Trees are declining, leading to scattered mortality.	Scattered throughout the West Central and Northwest Regions and Waupaca County

Pest	Host	Damage	Location

Pine (continued)

Bark beetles *(Pityogenes hopkinsi)*	White Pines	Tree mortality.	Door County.
Dothistroma Needle Blight *(Dothistroma pini)*	Austrian pine	Needle necrosis	Washington County.
Gall Rust *(Cronartium quercuum; Endocronartium harknessii)*	Jack and Scotch Pines	Decline in tree vigor, leading to branch and/or tree mortality.	Scattered throughout the West Central Region
Introduced Pine Sawfly *(Diprion similis)*	pine	defoliation	Marinette County
Ips Bark Beetles *(Ips spp.)*	Jack, red, white & Scotch pines	Tree mortality	Scattered throughout the West Central Region and Waupaca County
Jack Pine Budworm (Choristoneura pinus)	Red Pine	Light defoliation to young red pine plantaions (approx. 25 years old).	Eau Claire and Marathon Counties
Pine False Webworm *(Acantholyda erythrocepala)*	White Pine	Heavy defoliation	Portage County
Pine Root Collar Weevil *(Hylobius radicis)*	Red, Scotch, and White Pines	Girdling of root collar area and tree death	Scattered throughout the West Central Region, in poor sites in Washburn County; Waupaca, Oconto, Brown counties
Planted too deep.	Red Pine	Tree mortality	Wood County
Red Pine Pocket Decline	Red Pine	Pocket mortality	Scattered in West Central Region and Marinette, Waupaca, and Green Lake counties
Red turpentine beetle *(Dendroctonus valens)*	Red Pine	Trees have declining vigor, and can help lead to tree mortality.	Scattered throughout West Central Region and Waupaca,Marinette, Waupaca, Waushara counties
Redheaded Pine Sawfly *(Neodiprion lecontei)*	Red pine	Defoliation	Marinette, Shawano counties
Sphaeropsis Shoot Blight and Collar Rot *(Sphaeropsis sapinea)*	Jack and Red Pines	New shoot death with shepherd's crook and/or entire branch mortality.	Scattered throughout the West Central Region
Unknown	White pine	Thin crowns with some stunting & discoloration of needles	Scattered throughout the West Central Region
White Grubs	red pine	root damage	Shawano, Oconto counties
White Pine Blister Rust *(Cronartium ribicola)*	White Pine	Trunk and branch cankers. Some tree and branch mortality.	Scattered throughout the West Central Region and Marinette and Door counties
White pine sawfly *(Neodiprion pinetum)*	white pine	Defoliation	Dane County.
White Pine Weevil (Pissodes strobi)	Jack, Scotch, and White Pines	Terminal leader killed on open grown saplings. Open grown Jack Pine was preferred over open grown White Pine in the same area.	Scattered throughout the West Central Region and Waupaca County
Zimmerman Pine Moth *(Dioryctria zimmermani)*	Jack, Red and White Pine	Pitch flow on main trunk usually around the branch whorls at site of the attack, may cause decline in vigor.	Scattered throughout the West Central Region and Waukesha County.
Common Pine Shoot Beetle *(Tomicus piniperda)*	Pine, Fir, and Spruce.	WI DATCP found this exotic bark beetle in 2 new counties - Jackson & Sauk. These were added to the federal list for a total of 9 quarantined counties. in WI. The quarantine affects pine, fir, and spruce products.	Dane, Grant, Green, Jackson, Kenosha, Lafayette, Rock, Sauk, and Walworth counties.

Pest	Host	Damage	Location
Spruce			
Aphids *(Cinara spp.)*	White Spruce	Needle discoloration.	Clark and Portage counties
Eastern Spruce Gall Adelgid *(Adelges abietis)*	White Spruce	Branch galls	Scattered throughout the West Central Region, greatly increased in Washburn and Sawyer counties
Flood & Phytophthora root rot	White spruce	Mortality	Dodge County.
Leucostoma (=Cytospora) Canker *(Leucostoma kunzei)*	White Spruce	Branch mortality and loss of vigor. Pitch flow on the branches and main trunk and associated sunken area where the canker has formed.	Eau Claire and Marathon counties
Pitch Mass Borer *(Vespamima pini)*	White Spruce	Pitch masses on trunk, some deline in vigor.	Eau Claire and Marathon counties
Rhizosphaera Needlecast *(Rhizosphaera kalkhoffii)*	Colorado Blue and White Spruce	Needle discoloration ranging from purple to brown and needle loss.	Scattered throughout the West Central Region and Green Lake County
Spider Mites *(Oligonychus ununguis)*	White Spruce	Needle discoloration	Clark and Portage counties
Spruce Beetle *(Dendroctonus rufipennis)*	White Spruce	Tree decline leading to tree mortality.	Eau Claire Countyunty
Spruce needle drop (associated fungus: *Setomelanomma holmii)*	White spruce	Trees from which the fungus S. holmii were isolated exhibited chlorosis/necrosis of older needles, and needle drop	Clark, Jefferson, Portage, Clark and Portage counties
Tamarack			
Larch bark Beetle	Tamarack	Pockets of mortality	Declining across northwest region
Larch casebearer *(Coleophora laricella)*	Tamarack, European larch	Light defoliation	Declining across northwest and north central regions
Larch needlecast	European larch	Present in fewer than 10% of trees; less than 25% defoliation	Polk County
Walnut			
Anthracnose *(Gnomonia leptostyla)*	Black Walnut	Black blothces on leaves, leaf chlorosis, defoliation	Throughout SCR and SER
Fall webworm *(Hyphantria cunea)*	Walnut	Webbing, defoliation	Sauk and Dane Countys.
Willow			
Elm Sawfly	Willow	Severe defoliation	Brown, Kewaunee counties

Jack Pine Budworm Survey Procedures and Results: 2004

Shane Weber, DNR Forest Entomologist
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Spooner, Wisconsin

Early larval survey

This survey is done on a yearly basis and is a key indicator of the presence of destructive budworm populations. Thirty shoots and staminate flowers that can be reached from the ground are checked for larvae. Since staminate flowers are often scarce, a majority of shots are usually used. A high plot, considered sufficient to cause moderate to severe defoliation, is defined as any plot with a count of 10 or more infested shoots and flowers.

Early Larval Populations

County	No. Plots	No. Infected Shoots	Infected Shoots/ Plots	No. High* Plots	% High Plots
Polk	15	14	0.93	0	0
Burnett	24	16	0.67	0	0
Washburn	21	18	0.86	0	0
Douglas	54	96	1.78	0	0
Bayfield	32	72	2.25	0	0
District	**146**	**216**	**1.48**	**0**	**0**

*High plots are defined as any one plot which contains 10 or more infested shoots or flowers

Early Larval Population Trends

	No. Infested Shoots/Plot						% High Plots				
County	2000	2001	2002	2003	2004	% Change 2003-2004	2000	2001	2002	2003	2004
Polk	2.47	6.00	0.60	0.13	0.93	**+515**	6.7	26.7	0	0	0
Burnett	1.08	0.83	0.63	0.71	0.67	**-6**	0	0	0	4.2	0
Washburn	0.24	0.52	0.52	0.19	0.86	**+353**	0	0	0	0	0
Douglas	0.36	0.28	0.35	0.48	1.78	**+271**	0	0	0	0	0
Bayfield	0.09	0.13	0.16	0.59	2.25	**+281**	0	0	0	0	0
District	**0.62**	**0.97**	**0.40**	**0.47**	**1.48**	+215	**0.7**	**2.8**	**0**	**0.7**	**0**

Jack Pine Budworm Pupal Survey

This survey is also conducted annually and gives a good indication of the kinds and numbers of pupal parasites in the population as well as next year's population of jack pine budworm. It is done in July when most insects are in the pupal stage. Some adults may already have emerged, but empty pupal cases are collected and counted as emerged moths. At each stop, pupae are collected on a time basis. If five pupae are not found in five minutes, the collection is terminated. If five pupae are found in 5 minutes or less, the collection is continued until 25 pupae are found or until 15 minutes have elapsed. The time required to find 25 pupae is then recorded. Adults, parasites and non-emergence are recorded for each pupae.

2004 Pupal Survey

				Moths		Parasites		Not Emerged	
County	**Total Pupae**	**Total Minutes**	**Pupae/ Min**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Polk	62	93	0.67	32	51.6	24	38.7	6	9.7
Burnett	157	169	0.93	69	43.9	69	43.9	19	12.2
Washburn	180	163	1.10	79	43.9	81	45.0	20	11.1
Douglas	662	446	1.48	411	62.1	172	26.0	79	11.9
Bayfield	346	250	1.38	260	75.1	61	17.6	25	7.3
District	**1,407**	**1,121**	**1.26**	**851**	**60.5**	**407**	**28.9**	**149**	**10.6**

Pupal Population Trends

County	2001 Pupae/min	2002 Pupae/min	2003 Pupae/min	2004 Pupae/min	%Change 2003-2004
Polk	0.57	0.28	0.11	0.67	+509
Burnett	0.31	0.30	0.53	0.93	+75
Washburn	0.13	0.11	0.52	1.10	+112
Douglas	0.13	0.23	0.51	1.48	+190
Bayfield	0.03	0.08	0.49	1.38	+182
District	**0.19**	**0.20**	**0.48**	**1.26**	**+163**

Jack Pine Budworm Parasite and Predator Complex

This survey involves a careful examination of all the budworm pupae collected which do not produce moths. Adult specimens are compared to a reference collection. Any unknown adults are sent to the University of Wisconsin for identification. Pupal cases from which nothing emerges are dissected to ascertain the cause of failure.

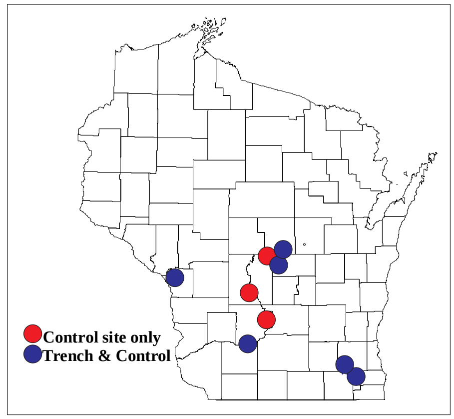
Parasite/ Predators	Polk	Burnett	Washburn	Douglas	Bayfield	Total	% of Parasitized	% of Total
Itoplectes	14	45	55	55	8	**177**	43.5	12.6
Scambus	0	4	2	6	5	**17**	4.2	1.2
Phaogenes	0	1	2	6	8	**17**	4.2	1.2
Pteromalids	0	0	0	16	6	**22**	5.4	1.6
Tachinids	3	8	10	39	17	**77**	18.9	5.5
Predators	7	11	12	50	17	**97**	23.8	6.9
Total	**24**	**69**	**81**	**172**	**61**	**407**	**100**	**28.9**

Sally Dahir
Forest HEalth Technician
DNR, Fitchburg WI

—This year, progress was made on several fronts in studying red pine pocket mortality in Wisconsin. These included:

1. The initiation of a National Science Foundation project coordinated by Prof. Ken Raffa of the Department of Forest Entomology at UW Madison in collaboration with the Dept. of Natural Resources Forest Health Protection Program, and other experts from around the country
2. The second year of a project conducted by DNR forest health staff mapping pocket expansion over time and investigating possible relationships between time of thinning and populations of bark beetles
3. A DNA analysis of *Leptographium* species conducted by Dr. Glen Stanosz of the University of Wisconsin, Madison.

In the first year of the NSF project, several sites were delineated for a root trenching trial (see map). There are 6 sites (blue dots) where both a trenched pocket (roots severed along the outside perimeter of dead trees) and an untrenched control pocket were established. In addition, 3 sites (red dots) will serve as controls only: either in untrenched symptomatic pockets or asymptomatic stands. Trenching was done in late April of 2004. At the same time, trees within and around the pockets were tagged, their crowns rated and insect traps set up. These traps were then monitored throughout the summer for several species of bark and root beetles.



In 2003, the first year of a project by Forest Health staff to monitor rates of pocket expansion, c. 123 pockets in over 50 stands were mapped. The center of each pocket was located with GPS and each tree was accurately mapped using a rangefinder. Symptomatic trees were then rated as to disease severity and the presence or absence of turpentine beetle pitch tubes. These pockets were revisited in the summer of 2004. New symptomatic trees were noted as was the presence of new pitch tubes. In conjunction with this project, turpentine beetle traps were set up in 2 groups of thinned stands. The first group had been thinned in the summer of 2003 and the second group in February through May of 2004. Traps were set up in early May 2004 but few turpentine beetles were caught. This may have been due to a 6 day period of extremely warm temperatures in mid-April (between 15 and 25 degrees (F) above normal in much of the state), which may have caused the flight season to occur in April before traps were set. This project will be repeated in 2005.

The third project involves the DNA analysis of fungal species involved in pocket expansion. Isolates of possible *Leptographium* fungus pathogens have been obtained from numerous collections of red pine bark and wood supplied by DNR Forest Health specialists. These fungi are being compared with known isolates from culture collections and other researchers around the US. Because morphological characteristics of these fungi can be variable and overlap (making identification difficult), DNA of these fungi is being studied. Particular differences in DNA sequence can provide “markers” for rapid and unambiguous identification of different fungal species. It is hoped that discovery of specific markers will allow clarification of the frequency and abundance of the various *Leptographium* species associated with dying red pines, and help to explain the initiation, distribution, and rate of expansion of red pine pocket mortality in Wisconsin.

2004 Emerald Ash Borer Detection Tree and Visual Survey Results in Wisconsin State Forest and Park Campgrounds

Mark Guthmiller and Renee Pinski
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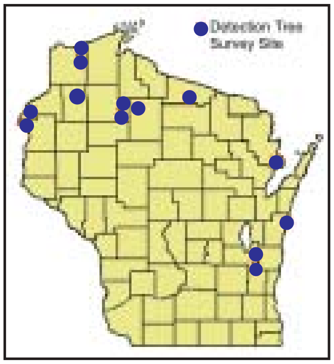

The devastating discovery of the emerald ash borer (*Agrilus planipennis*) in Michigan in 2002 prompted two surveys of our ash resource in Wisconsin: 1) a detection tree survey supplemented with a visual survey of all Wisconsin state forest campgrounds with an ash resource present and 2) a visual survey of all state park campgrounds(see report on pg. 28). Survey sites were prioritized as to the risk of introduction by movement of firewood from infested areas outside Wisconsin.

There were two main **objectives** to the detection tree survey:
1) to detect emerald ash borer
2) to learn about other wood-boring insects attracted to ash trees under stress.

A total of twenty four detection trees (see map above) were installed during spring 2004 in 10 state forest campgrounds, 1 county campground, and 1 state forest boat landing to monitor for the presence of emerald ash borer and other ash boring insects. Detection trees were installed by girdling and removing a section of bark to stress the tree by preventing water and nutrient flow. Research in Michigan has shown an increased attraction to these stressed girdled trees. A sticky band of plastic wrap, coated with a tangle trap product, was then applied above the girdled area to catch insects attracted to the tree (see photo on right). With the assistance of local foresters and park staff, detection trees were checked every other week from the beginning of June through September. Insects were collected from the sticky bands and stored in vials with rubbing alcohol for identification.

The detection trees were paired at each location. In addition to monitoring sticky bands for wood boring beetles, one of the paired detection trees was cut and debarked (see photo on left) in the fall to look for galleries and other signs of wood-boring insects. The trees at the end of this first year had very little insect activity. The two most common insects observed were the ash bark beetle (*Hylesinus sp*.) and the ash cambium miner (*Phytobia sp*.). The remaining tree at each site will be cut and debarked in the fall of 2005.

The **emerald ash borer was not detected by these surveys** and has not yet been confirmed in Wisconsin. Other wood-boring insects were collected and are being processed for identification. Emerald ash borer is in the taxonomic family Buprestidae, commonly known as metallic wood-boring beetles. Currently from our samples we have collected a total of 22 buprestid beetles, none of which are emerald ash borer (see table on next page). These 22 beetles have been divided into 7 morphospecies (see photo on right). Morphospecies were assigned to beetles with similar visible appearance (Coded A-G,). Morphspecies G was not able to be pinned and photographed and is absent from photo). This coding is used only until taxonomic identifications are made. These samples will be sent to a specialist for further identification.

Emerald ash borer was not collected and is for comparison only

A visual survey of each of the detection tree sites was also conducted during the summer. In addition, the Manitowoc Ferry park area was also surveyed. This involved looking for signs and symptoms of emerald ash borer. No evidence of emerald ash borer was detected during these surveys. A number of declining ash trees were noted at the entrance area to Long Lake Campground in the Northern Unit of the Kettle Moraine State Forest and at a picnic area in the Bois Brule campground of the Brule River State Forest. Ash yellows was suspected at the Long Lake site and possibly weather-related issues at the Bois Brule site. The Point Beach State Forest campground was also experiencing some ash dieback and mortality in the low areas and may be due to water level and root rot problems. Additional investigations may be warranted at these sites.

For more information on emerald ash borer go to these web sites:

EAB Survey results: http://www.dnr.state.wi.us/org/land/Forestry/FH/Ash/index.html#5
WI DNR Forestry EAB site: http://www.dnr.state.wi.us/org/land/Forestry/FH/Ash/index.html
MI EAB site: http://www.emeraldashborer.info

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During the summer of 2004, we conducted a visual survey of the ash resource in Wisconsin's State Park campgrounds (Table 1). The survey objectives were

1) to detect any emerald ash borer infestations and
2) to determine the overall health status of Wisconsin's ash trees.

We focused our survey efforts on ash trees in campgrounds because the risk of emerald ash borer infestation is higher in areas where firewood is frequently transported. Emerald ash borer larvae feed in the cambium region, between the bark and the wood, creating serpentine galleries. These galleries eventually girdle and kill the tree by depriving the crown of water and nutrients. Dispersal of this pest is accelerated by human intervention and the inadvertent transportation of larvae in logs, firewood and nursery stock.

Visual surveys were conducted June through September 2004. Data were collected from a maximum of two randomly selected ash trees per campsite. Data collection included ash pests or diseases present and emerald ash borer-like symptoms (branch dieback, epicormic sprouts, bark cracks and woodpecker damage) and signs (larvae, adults, S-shaped galleries, D-shaped exit holes).

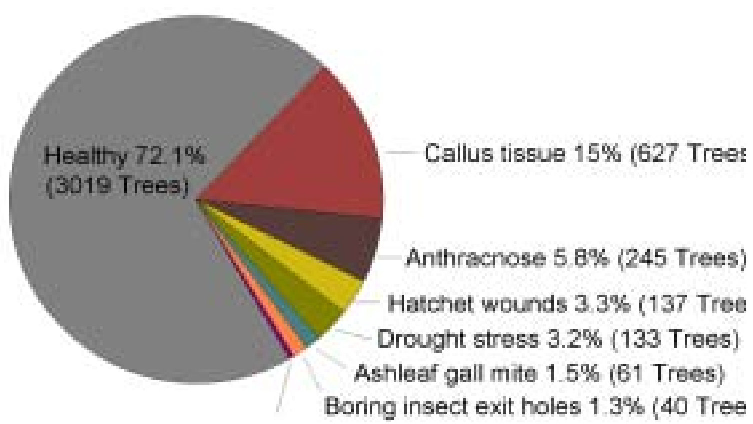


Figure 2. Predominant health issues observed on ash in Wisconsin's State Parks. Groupings of hatch marks represent a Sate Park. A total of 37 parks were surveyed.

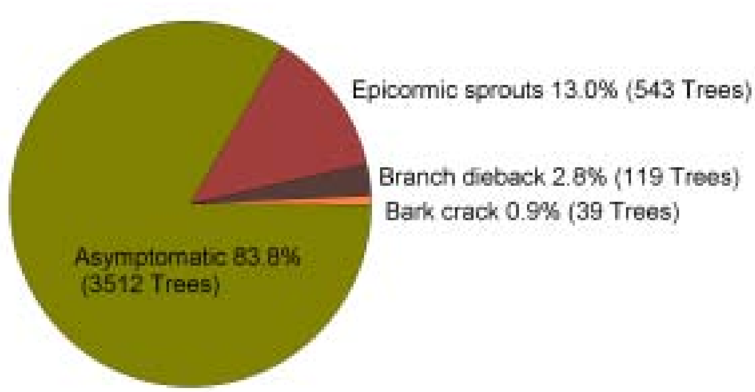


Figure 3. Emerald ash borer-like symptoms observed on ash trees at survey sites. No emerald ash borers were detected

In addition to campsite surveys, the ash resources in parking lots, picnic areas and firewood storage and selling areas were scanned visually, but no data were collected. However, if emerald ash borer-like symptoms were observed, a more detailed inspection of the tree was completed.

No emerald ash borer infestations were detected during visual surveys in 2004. A total of 4189 trees were surveyed across 37 state parks. The remaining state parks were not surveyed because they do not offer camping facilities.

The overall health status of the ash resource is good, with 72.1% of the trees surveyed being apparently healthy, while just 0.4% were dead (Figure 1). The predominant health issues observed were minor and include a variety of pathogens, mites and insects, abiotic disorders and vandalism. Generally, these health issues were widespread across survey sites (Figure 2 on next page).

Few ash pests and diseases were detected on the ash resource. The foliar fungus anthracnose (*Gnomoniella fraxini*) was the

Table 1: Total number of trees surveyed at each state park and the most commonly observed tree health disorder at that park.

State park	Number ash trees surveyed	Most commonly observed health disorder (*)
Amnicon Falls	17	Anthracnose (4)
Big Bay	32	Callus tissue from unidentified wounding (6)
Big Foot Beach	60	Branch dieback (4)
Blue Mound	135	Callus tissue from unidentified wounding (17)
Brunet Island	32	Epicormic sprouts (7)
Buckhorn	29	Callus tissue from unidentified wounding (10)
Capital Springs	4	All trees healthy (4)
Copper Falls	71	Callus tissue from unidentified wounding (6)
Council Grounds	50	Callus tissue from unidentified wounding (13)
Devil's Lake	533	Callus tissue from unidentified wounding (128)
Governor Dodge	278	Epicormic sprouts (42)
Hartman Creek	55	Callus tissue from unidentified wounding (14)
High Cliff	183	Callus tissue from unidentified wounding (38)
Interstate	92	Epicormic sprouts (19)
Kettle Moraine-S	195	Epicormic sprouts (24)
Kohler-Andrae	142	Epicormic sprouts (38)
Lake Kegonsa	48	Anthracnose (2)
Lake Wissota	24	Ashleaf gall mite (2)
Merrick	77	Epicormic sprouts (23)
Mill Bluff	12	Drought stress (3)
Mirror Lake	21	Callus tissue from unidentified wounding (5)
Nelson Dewey	43	Callus tissue from unidentified wounding (7)
New Glarus	7	All trees healthy (7)
Pattison	99	Anthracnose (35)
Peninsula	654	Callus tissue from unidentified wounding (91)
Perrot	102	Epicormic sprouts (30)
Pike Lake	119	Anthracnose (20)
Potawatomi	159	Callus tissue from unidentified wounding (36)
Rib Mtn.	51	Epicormic sprouts (14)
Richard Bong	459	Drought stress (68)
Roche-A-Cri	19	Callus tissue from unidentified wounding (2)
Rocky Arbor	31	Callus tissue from unidentified wounding (3)
Tower Hill	5	Epicormic sprouts (3)
Wildcat Mtn.	50	Epicormic sprouts (13)
Willow River	8	Epicormic sprouts (1)
Wyalusing	172	Epicormic sprouts (53)
Yellowstone Lake	121	Callus tissue from unidentified wounding (27)

* Number of trees with the specified health disorder.

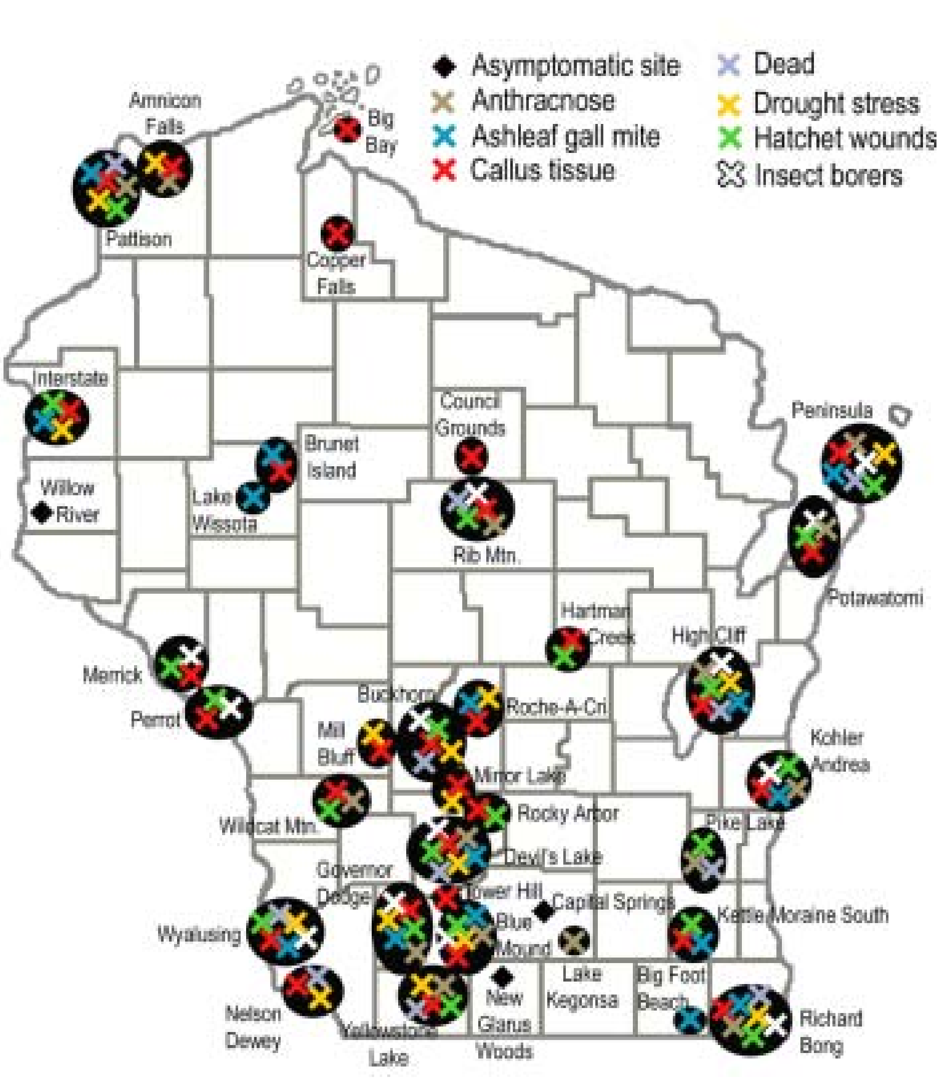


Figure 2. Predominant health issues observed on ash in Wisconsin's State Parks. Groupings of hatch marks represent a Sate Park. A total of 37 parks were surveyed.

most frequently observed disease, affecting 5.8% of ash trees. The leading cause for this pathogen's abundance was the result of the long, cool wet spring we had over much of the state in 2004. Mite and insect pests affected a small percentage of the ash resource. Light infestations of a common mite pest, the ashleaf gall mite (*Aceria chrondriphora*) were observed on 1.5% of the trees surveyed. Insect pests included the redheaded ash borer (*Neoclytus acuminatus*), the ash bark beetle (*Hylesinus* sp.) and the ash borer (*Podosesia syringae*). Overall, the presence of these wood-inhabiting pests was rare, with just 1.3% of ash trees affected.

Abiotic disorders were more prevalent than pests and diseases on the ash trees surveyed. Predominant abiotic disorders included drought stress and vandalism. Past years of summer drought have negatively impacted the ash resource by causing thin crowns with tufted foliage. Trees with drought stress were scattered throughout the state and symptoms occurred on 3.2% of the ash resource. Vandalism by far had the largest impact on ash tree health. Overall, 15% of all trees surveyed had callus tissue on the main stem and within 6 feet of the ground. It is suspected that this may have resulted from vandalism. Probable causes include wounding due to hatchets, nails, lanterns, clotheslines, automobiles and campers. In addition to callus tissue, hatchet wounds that had not yet callused over were observed on 3.3% of ash trees. A far less common abiotic disorder was evident at Pattison State Park. The black ash trees had severe branch dieback, but there were no signs of insects or diseases. Speculation leads us to believe that frost damage to the fine roots during the winter of 2002 was a leading factor to this disorder.

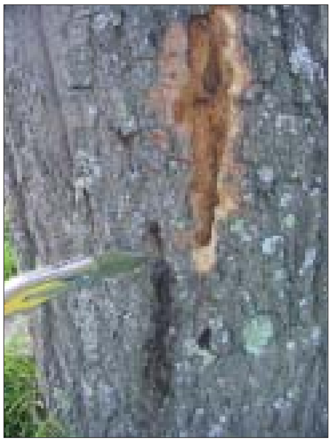
There were a few ash health issues observed whose causal agents are suspected, but have not been confirmed. It is suspected that the ash decline observed at Wyalusing and Nelson Dewey State Parks is due to the phytoplasma ash yellows. Brooms, a definitive symptom for identification, were observed at both parks. Meanwhile, at Peninsula State Park there were numerous trees with scorched, wilted foliage. These symptoms are often associated with verticillium wilt or root diseases. Laboratory testing will be necessary before confirmation of either ash yellows or verticillium wilt can be made. Possible testing is to occur this spring.

Despite the fact that no emerald ash borer infestations were located, there were numerous emerald ash borer-like symptoms observed on ash trees across survey sites. It is important to note that there are numerous pests and pathogens, many of which have been named here, that cause symptoms similar in appearance to those created by the emerald ash borer. Epicormic sprouts, branch dieback and bark cracks were observed on 13%, 2.8% and 0.9% of ash trees, respectively (Figure 3). It may be important to conduct follow-up visits to emerald ash borer-like symptomatic trees in 2005. Surveyors from Michigan and other emerald ash borer infested areas are finding that they typically do not detect emerald ash borer infestations by using visual survey techniques until the tree has been infested for three to four years.

Additional information and images of the commonly occurring pests and diseases mentioned in this report can be downloaded and viewed as a PDF from the WI DNR emerald ash borer web page, http://dnr.wi.gov/org/land/Forestry/FH/Ash/index.html , by clicking on the section titled "Results of 2004 Emerald Ash Borer Detection Surveys". Here you will also be able to locate information regarding the detection tree survey that was conducted for emerald ash borer in Wisconsin's State Forests during 2004.

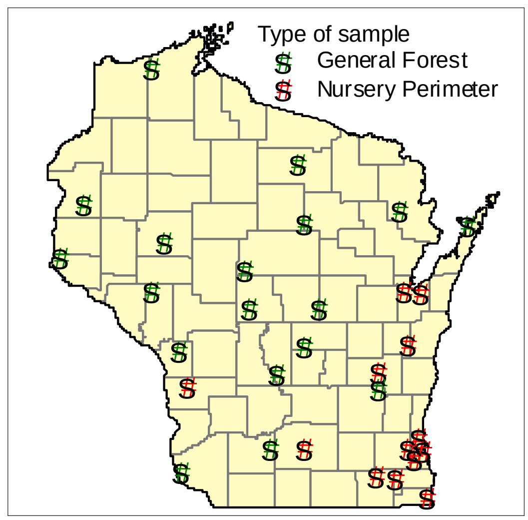
Phytophthora ramorum

—Since the mid 1990's mortality of several species of oak has been detected in northern California. A new disease caused by a fungus-like organism *Phytophthora ramorum* has been identified and is now know to occur in 14 coastal California counties from Monterey to Humboldt, as well as in Curry County, Oregon.



The origin of this disease is unknown. It causes bleeding cankers (see photo) on several trees including tanoak, coast live oak, California black oak, Shreve oak, and canyon live oak. Infected trees typically die several years after infection. This disease also causes leaf spots, and branch tip dieback on a wide variety of woody understory species. Pathogenicity tests have shown that northern red oak, Quercus rubra is susceptible.

In 2003, plant inspectors found that nursery stock had been shipped from an infected nursery in southern CA to several states, including WI. This prompted a national survey in 2004 of nurseries receiving this stock and the oak woodlands surrounding these nurseries. Dr. Neil Heywood, a UW Stevens Point professor from the Department of Geography & Geology was hired by DNR to conduct this survey. Eighty-one sites were examined and 31 chosen for close inspection (see map). DNR and DATCP cooperated in this effort; DATCP surveyed nurseries and DNR surveyed 13 oak woodlands within 0.25 mile of selected nurseries and 18 additional oak sites throughout the state. Samples (409) included understory vegetation with leaf spots resembling those caused by *P. ramorum* and tissue from bleeding oak cankers. Samples were sent to Ohio State and Mississippi State for analysis. All samples were negative for *P. ramorum*. Wisconsin will continue to participate in the national survey in 2005.



In addition to the planned SOD survey, several reports of oak dieback and mortality were investigated during 2004. A small group of dying oaks on the south side of Minoqua were closely examined and sampled as they showed symptoms of SOD including small bleeding cankers and dieback on red oak. Samples of Rhododendrons from a nursery in close proximity to the dying oaks were also taken. Analysis was conducted by the Wisconsin Department of Agriculture, Trade and Consumer Protection. ***All samples were negative for Phytophthora ramorum.*** The oak dieback and mortality is a result of several years of defoliation by the forest tent caterpillar, drought and infestation by the two-lined chestnut borer. The weeping cankers are likely a symptom of wetwood, a bacterial disease of hardwoods or may be caused by another species of Phytophthora.

Phytophthora Survey in Declining Oak Stands

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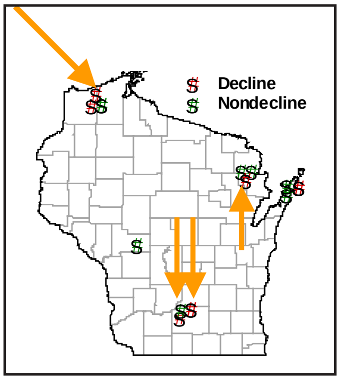
Plant Pest and Disease Specialist
Wisconsin Department of Natural Resources

In coastal areas of California and Oregon the fungus *Phytophthora ramorum* was recently confirmed causing a disease on oak and other host species called "Sudden Oak Death". Current knowledge of native and exotic *Phytophthora* species in our local oak ecosystem is not well known. This has prompted surveys of declining oak stands in the north central and eastern United States. This particular survey was conducted to learn more about other *Phytophtora* species associated with oak stands, particularly declining oak stands.



In Wisconsin, eight oak stands (4 declining and 4 non-declining) were surveyed in late May and early June for the presence of *Phytophthora* fungi in the soils(see map). Plots were established with site and tree data taken. Soil was sampled at the bases of five trees at each site and sent to the Forest Service in St. Paul for processing. Results of the spring collection showed the presence of *Phytophthora* fungi at 4 of the eight sites (3 declining stands and 1 non-declining stand, orange arrows in map to left). The species of *Phytophtora* fungi present have not yet been determined by the Forest Service but are not *P. ramorum*, the fungus that causes "Sudden Oak Death".

A second fall sampling was conducted at all the previous sites negative for *Phytopthora* in the spring sampling. Replacement sites were found to replace the three positive sites (Note: At time of the second survey Vienna Township site in Dane County was negative. Later testing did however recover an isolate of *Phythophthora*.). Results of the fall sampling were negative for Phytopthora at all 8 sites. Below is a county and township listing of all sites with results .

Spring survey locations and results:
Dane Co., Vienna Township : **positive**, decline site
Dane Co., Berry Township: **positive**, non-decline site
Door Co., Gibraltar Township (Peninsula S.P., Skyline Dr.): **negative**, non-decline site
Door Co., Gibraltar Township (Peninsula S.P., Welckers Pt.): **negative**, decline site
Douglas Co., Brule Township (Hwy H): **positive**, decline site
Douglas Co., Highland Township (Hunter trail): **negative**, non-decline
Marinette Co., Stephenson Township (Tommy Thompson S.P.): **negative**, non-decline site
Marinette Co., Stephenson Township (Seymor Rapids Trail): **positive**, decline site

Fall survey locations and results:
Dane Co., Vienna Township: **negative,** decline site
Dane Co., Cross Plains Township: **negative,** NEW, decline site
Door Co., Gibraltar Township (Peninsula S.P., Skyline Dr.): **negative,** non-decline site
Door Co., Gibraltar Township (Peninsula S.P., Welckers Pt.): **negative,** decline site
Douglas Co., Highland Township (Hazel Prairie Rd): **negative,** NEW, decline site
Douglas Co., Highland Township (Hunter trail): **negative,** non-decline site
Jackson Co., Millston Township (Wildcat trail): **negative,** NEW, non-decline site
Marinette Co., Stephenson Township (Tommy Thompson S.P.): **negative,** non-decline site

For more information on "Sudden Oak Death" go to:
http://www.fs.fed.us/r5/spf/local-resources/documents/sod-mapping-monitoring.shtml
http://www.na.fs.fed.us/spfo/pubs/pest_al/sodeast/sodeast.htm

Using spatial data to predict the occurrence of forest health problems

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Risk mapping has recently gained popularity as a way to direct public and political attention to emerging issues of importance to forest health. By visually representing the threat to our forests created by pests or invasive plants, spatial modeling presents a more startling and immediate representation of these issues. The danger of course in doing this, is that certain issues become politically "popular" while other more imminent problems might not gain the necessary public concern. The purpose of this article, however, is merely to explain one process of risk modeling which we have undertaken in Wisconsin.

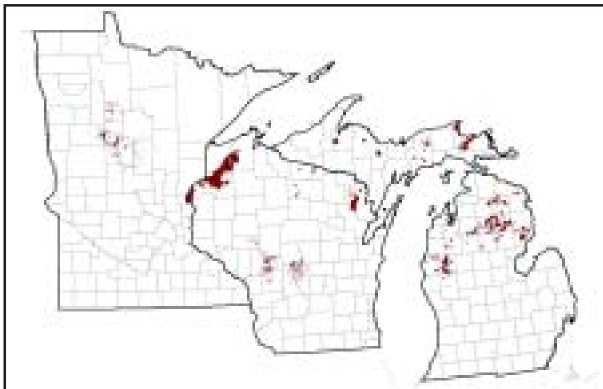

Figure 1. Areas historically defoliated by jack pine budworm

Figure 2. Map of jack pine basal area based on FIA plot data.

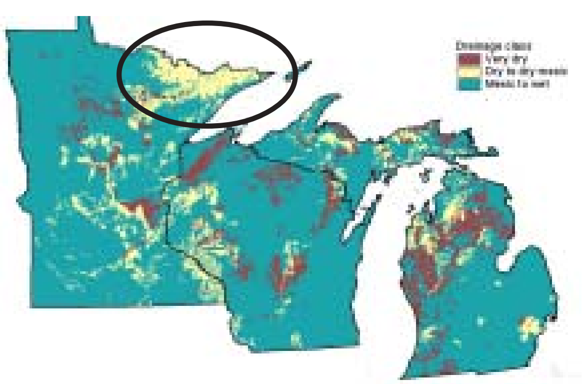

Figure 3. Drainage index in northern Minnesota where jack pine occurs is much higher than in the areas where jack pine is defoliated.

There are many ways to model data spatially. We have used both a modeling program in ArcView called ModelBuilder as well as a statistical regression method using ArcView Spatial Analyst. Modelbuilder was used to predict defoliation of jack pine by the jack pine budworm (*Christonuera pinus*) and regression was used to predict the occurrence of the invasive shrub buckthorn (*Rhamnus spp*). Both techniques have in common the necessity of carefully choosing independent variables and of weighting and overlaying these spatial datasets in a way that most accurately reflects the probability or risk being modeled.

Modeling jack pine budworm defoliation with ArcView Modelbuilder

Jack pine defoliation by budworm has occurred at regular intervals (of approx. 10yrs) in Michigan, Minnesota and Wisconsin. We have survey data dating from the 1950s, but the most accurate maps are from aerial surveys done for the early 1990s outbreak (Figure 1). If we overlay this data on a map of estimated jack pine basal area (Figure 2), we see that the areas of defoliation seem to overlay quite accurately with areas of high basal area except in the region of northern Minnesota. This area typically shows little if any defolation during outbreaks elsewhere. A map of soil drainage index (Figure 3) reveals that this area has a high index value (high values reflect poor soil drainage). The areas where jack pine is typically defoliated all have drainage index values below about 13. From this we conclude that we will see the highest risk of defoliation both in areas of high jack pine basal area and low soil drainage index. Our final map (on the next page) showing areas in red and blue as moderate to high risk of budworm defoliation, coincides fairly well with areas that have historically shown high levels of damage to this insect.

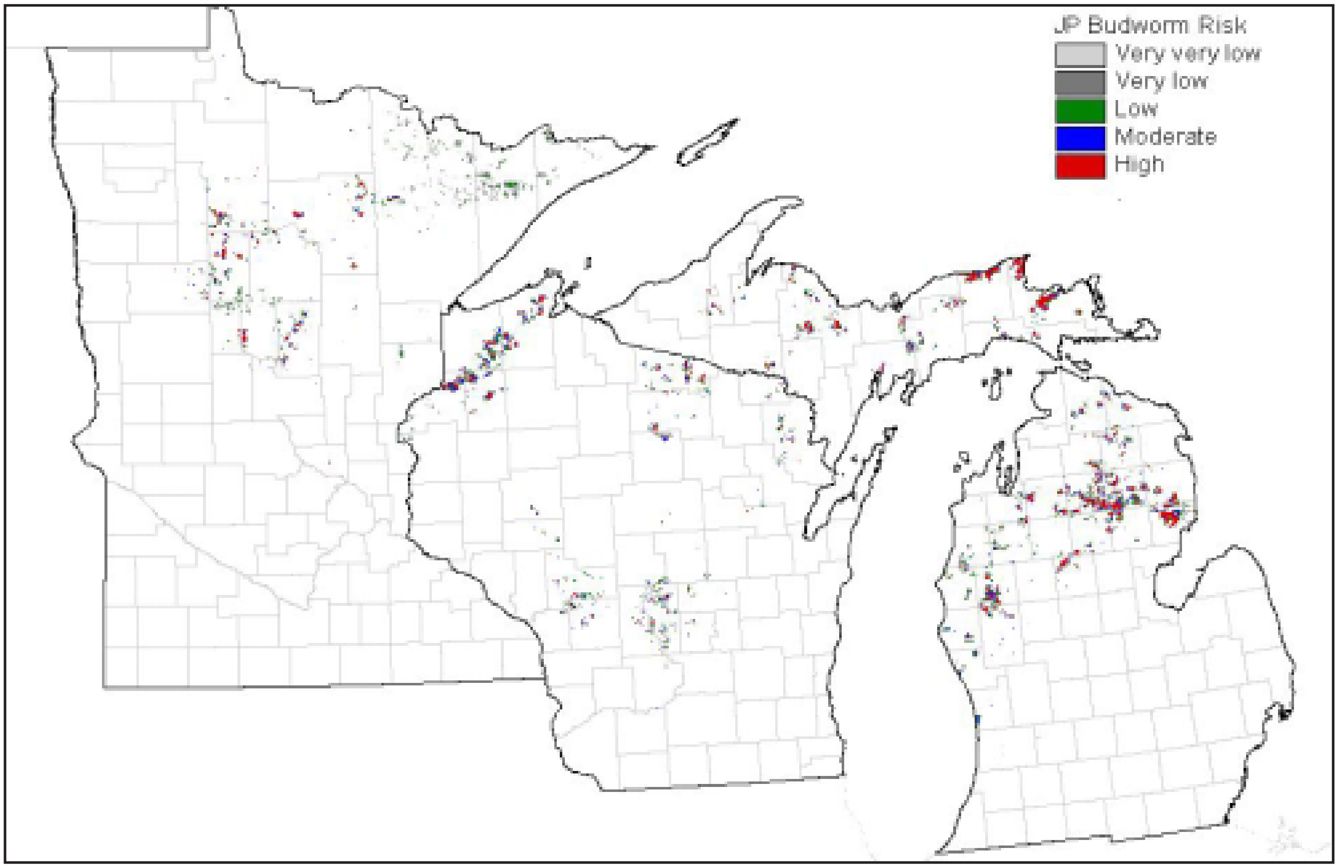

Figure 4. Final risk map depicting highest risk of mortality from jack pine budworm in red.

Modeling the occurrence of invasive buckthorn using logistic regression

The second method of modeling we used was based on logistic regression, a statistical technique traditionally used to predict risk or probabity. The formula:

$$\pi = \frac{\exp(x)}{1 + \exp(x)}$$

limits the value of π to the range 0 to 1. We used logistic regression to predict the probability of the occurrence of buckthorn in southern Wisconsin (Province 222). The data used to calibrate the equation came from 1996 FIA (Forest Inventory and Analysis) plot data. All herbaceous plants and shrubs were recorded in order to determine habitat type. Only plots from province 222 that had recorded species lists were used. The variables that were most significant and were positively correlated to the occurrence of buckthorn on FIA plots were:

1. Proximity to large urban area (cities with over 50,000 inhabitants)
2. Proximity to major roadways
3. Lower elevation
4. Dry-mesic, mesic or wet-mesic habitat type
5. Public ownership
6. Location in more fragmented forests and grasslands

Data from individual FIA plots was then converted to raster data by using Spatial Analyst in ArcView 3.3. Digital elevation maps provided data on elevation and land ownership data. The habitat type surface map, based on FIA plots, was created using interdistance weighted interpolation (see Forest Health Conditions in Wisconsin, Annual

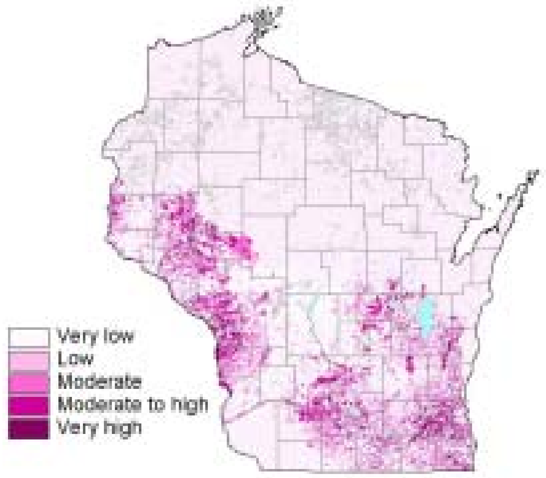

Figure 5. Probability of the occurrence of buckthorn

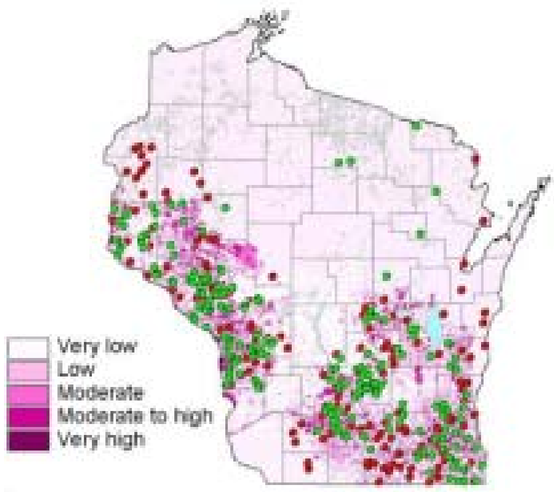

Figure 6. If FIA plots (green dots represent 1996 plots and red dots are 2000-2003 plots) are overlain on the risk map, it is apparent that buckthorn is spreading into Barron and Polk counties.

Report 2000, 2001, pp 43-48). The spatial dataset for forest fragmentation was created using Wiscland (Landsat) data (fragmented forest was defined as any part of a forested stand that was less than ½ mile wide).

Figure 5 shows the probability of buckthorn occurrence in southern Wisconsin. Buckthorn is fairly evenly distributed throughout most of southern Wisconsin outside of the central sands area, extreme southwestern Wisconsin, and most of Dodge county. The main variable distinguishing these areas is the long distance to major urban areas as defined above. The overlay of the 1996 FIA plots (Figure 6) shows a fairly good match with the newer plots (2000-2003 data) in red showing the spread of buckthorn into Polk and Barron counties. Again the model was based on 1996 plot data only.

Summary

These two methods are presented here to give you a basis for understanding the process of risk mapping. We are working to expand and improve the accuracy of many of the datasets upon which this mapping will be based. We are also investigating the integration of nonforestry datasets, including census data (home construction, seasonal homes, population characteristics), data from Wisconsin businesses (locations of forest industry, campgrounds, tree nurseries), climate data (average temperatures, precipitation,etc), habitat type and soils data with host presence and vulnerability to derive maps projecting possible risk of several forest health problems as well as the placement of forest health personnel to best address future needs. No doubt, you'll be seeing more of this in the future.

Pitch Canker Like Symptoms Detected

in Southern Unit of Kettle Moraine State Forest

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Figure 1

Disease issues affecting red pine plantations over the last few years in the southern unit of the Kettle Moraine State Forest in southeast Wisconsin has prompted a number of surveys. During surveys for Diplodia shoot blight, Annosum root rot, and red pine pocket mortality, symptoms and signs similar to those of pine pitch canker (*Fusarium circinatum*) were observed in one location. The symptoms were very similar to Diplodia shoot blight and in deed Diplodia was also present on the same trees sampled.

The trees sampled had heavy dried resin pitch on the surface of the branches. When bark was peeled back the inner wood surface was resin soaked (Figure 1). Orange fruiting structures (Figure 2) similar in shape to the

Figure 2

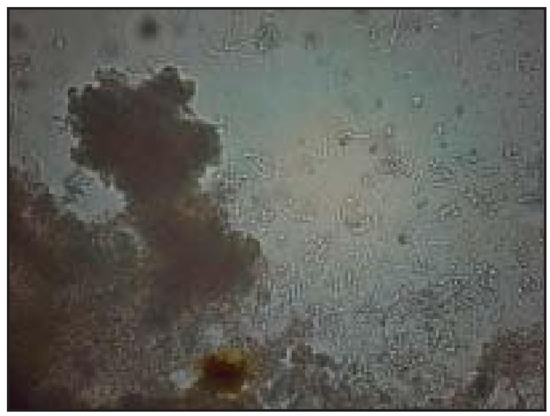

Figure 3

sporodochia of pitch canker were observed on the bark surface directly above the area with resin pitch (pitch canker sporodochia are noted as salmon to pink in color unlike these orange structures). Fruiting by Diplodia was also often observed on the same branchs but not near these cankers. In addition to the branches, the cones contained both pycnidia of Diplodia and the Fusarium like sporodochia. Sampling of these sporodochia fruiting bodies revealed polyphialid-like structures which produce conidia.

Future investigations are needed to determine if this fungus is indeed related to the genus Fusarium and also if it is of any major health concern to the red pine.